

MURFREESBORO WATER RESOURCES DEPARTMENT

MURFREESBORO, TENNESSEE

STANDARD

TECHNICAL SPECIFICATIONS

AND

DETAIL DRAWINGS

FOR THE INSTALLATION OF

SANITARY SEWER MAINS & APPURTENANCES

January 2019

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MURFREESBORO WATER RESOURCES DEPARTMENT



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SECTION 02221S

TRENCHING, BEDDING AND BACKFILLING For SANITARY SEWERS (GRAVITY)

PART 1 – GENERAL

1.1 SCOPE OF WORK

The work covered by this Section consists of loosening, loading, removing, and disposing of, in the specified manner, all wet and dry materials (including rock) encountered that must be removed for construction of gravity sanitary sewers; furnishing, placing, and maintaining all sheeting, shoring, bracing, and timbering necessary for the proper protection and safety of the work, the workforce, the public, and adjacent property and improvements; the dewatering of trenches and other excavations; the preparation of satisfactory pipe beds; the backfilling and compaction of trenches, foundations, and other structures; the removal of unsuitable material from outside the normal limits of excavation, and where ordered by the Engineering, their replacement with suitable materials; and all other grading or excavation work incidental to or necessary for the work.

1.2 PERMITS AND NOTIFICATIONS

The Contractor shall be responsible for obtaining all the local permits, to include street cut permits, required and for notifying Tennessee One Call to locate all the existing utilities.

PART 2 – PRODUCTS

2.1 NOT APPLICABLE

PART 3 – EXECUTION

3.1 TRENCH EXCAVATION

All excavation shall be by open cut unless otherwise shown on the plans or specified herein. No tunneling shall be done without the approval by the Engineer of the tunnel cross section and details of construction. The top portion of trenches may be excavated with sloping or vertical sides to any width which will not cause damage to adjoining structures, roadways, pavements, utilities, or private property and which comply with all OSHA and TOSHA Standards. For untimbered trenches or trenches held by stay bracing only, except trenches excavated in rock using a trenching machine, the width of the lower portion of the trench to a height of two (2) feet above the top of the pipe shall not exceed $4/3d + 15''$ where d represents the nominal internal diameter of the pipe in inches. The

width of trenches where skeleton or solid sheeting is used may be increased to dimensions approved by the Engineer, but not greater than necessary to clear the whalers when lowering pipe into the trench.

When approved in writing by the Engineer, the banks of trenches from the ground surface down to a depth not closer than two (2') feet above the top of the pipe may be excavated to nonvertical and nonparallel plans, provided the excavation below that depth is made with vertical and parallel sides equidistant from the pipe centerline in accordance with the criteria given above and provided they comply with all OSHA and TOSHA Standards. Any cut made in excess of the formula $4/3d + 15''$, except as noted above, shall be at the expense of the Contractor and may be cause for the Engineer to require that stronger pipe and/or a higher class of bedding be used.

Should the Contractor excavate below the required depth, the Contractor shall, at no cost to the Owner, bring the excavation to proper grade by filling the void with clean crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction.

Wherever muck, quicksand, soft clay, swampy ground, or other material unsuitable for foundations, subgrade, or backfilling is encountered, remove it and continue excavation until suitable material is encountered. The material removed shall be disposed of in the manner described in paragraph 3.4 Disposal of Materials. Refill the areas excavated for this reason with one to two (1" to 2") inch crushed stone up to the level of the lines, grades, and/or cross sections shown on the Plans. The top six (6") inches of this refill shall be crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction.

Trenches shall be opened up far enough ahead of pipe laying to reveal obstructions, but in general shall not include more than two hundred (200') feet of continuous open trench at any time. The Contractor will be required to follow up trenching operations promptly with pipe laying, backfill if an inspector is present, and rough cleanup, and in the event of failure to do so, may be prohibited from opening additional trench until such work is completed. This requirement is particularly applicable to work being done in developed areas.

Where trenches cross streets, walks, driveways, and other points as may be directed by the Engineer, the trenches shall be bridged in an open and secure manner, so as to prevent any serious interruption of travel upon the roadway or sidewalks, and also to afford necessary access to public or private premises. No driveways shall be cut or blocked without giving twenty-four (24) hour notice to the occupant of the property. Effort shall be made to schedule the blocking of drives to suit the occupant's convenience, and except in case of emergency, drives shall not be blocked without an alternate access being provided. The material used, and the mode of construction of said bridges and the approaches thereto, must be satisfactory to the Engineer.

3.2 EXCAVATION FOR MANHOLES AND OTHER STRUCTURES

Excavation for manholes and other incidental structures shall not be greater in horizontal area than that required to allow a two (2') foot clearance between the outer surface of the structure and the walls of the adjacent excavation or of the sheeting used to protect it. The bottom of the excavation shall be true to the required shape and elevation shown on the Plans. No earth backfilling will be permitted under manholes or similar structures. Should the Contractor excavate below the elevations shown or specified, the Contractor shall, at no cost to the Owner, fill the void with either concrete or clean crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction. Excavation for manholes and other structures may be performed with nonvertical banks except beneath pavements or adjoining existing improvements.

3.3 EXCAVATION IN SOLID ROCK

Solid rock shall consist of such materials in the original bed or well-defined ledges which, in the opinion of the Engineer, cannot be removed with pick and shovel, ditching machine, backhoe, or other similar devices, and which requires drilling and blasting, or the use of jackhammers or bullpoints. Concrete and masonry structures that require drilling and blasting for removal shall be considered as rock unless otherwise provided for herein. Boulders or detached pieces of rock having volumes of more than nine (9) cubic feet shall also be considered as rock. All rock shall be removed to provide a clearance of not less than nine (9") inches, (eighteen (18") inches when a trenching machine is used), in any horizontal direction from all parts of pipe, fittings and other appurtenances.

Excavate rock over the horizontal limits of excavation and to a depth of not less than six (6") inches below the bottom of the structure or pipe. Then backfill the space below grade with crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction, or other approved material, tamp to the proper grade, and make ready for construction.

Where sewers are constructed across cultivated fields and pastures, or in streets, excavated rock shall not be mixed with backfill material used to complete the final eight (8") inch layer of backfill at the original ground surface. Surplus rock shall be removed and wasted at points designated by the Owner.

Blasting operations shall be conducted in strict accordance with all existing ordinances and regulations and shall be done only after a pre-blast survey is done at no cost to the Owner by a firm approved by the Engineer. All exposed structures shall be carefully protected from the effects of the blast, and all blasts shall be covered with heavy timbers or other suitable material. The blasting shall be done only by experienced personnel certified by the State of Tennessee Fire Marshal's Office. Any damage done shall be promptly repaired at the Contractor's expense.

Rock excavation in proximity to other pipes or structures shall be conducted with the utmost care to prevent damage to the existing pipes or structures, and any such damage caused shall be promptly repaired at the Contractor's expense. Blasting operations shall not be conducted within ten (10') feet of finished sewer or water pipe. Contractor shall

blast an additional five (5') feet beyond the proposed end of the service line, stub line or dead-end manhole.

Extreme care shall be exercised in blasting, with signals of danger given before the firing of any charge. The Contractor shall, in all acts, conform to and obey all rules and regulations for the protection of life and property that may be imposed by any public authorities or that may be made from time to time by the Engineer, relative to the storing and handling of explosives and the blasting operations.

Where rock is encountered in the immediate vicinity of gas mains, telephone cables, building footings, gasoline tanks, or other hazardous areas, the Contractor shall remove the rock by means other than blasting. Care shall be taken in blasting operations to see that pipe or other structures previously installed are not damaged by blasting.

3.4 DISPOSAL OF MATERIALS

Excavated material shall be stored safely away from the edge of the trench and in such a way as to avoid encroachment on private property, danger to workers, utilities, or traffic, and to cause minimum inconvenience through blocking of drives, sidewalks, natural drains, etc.

Any surplus excavated material remaining after the trench backfill has been completed shall be removed from the site by the Contractor. The material may be stockpiled in a suitable location for use in correcting any future trench settlement if it meets the requirements of acceptable backfill. Surplus excavated material may be disposed of in other locations only after the Owner and the property owner have given permission and have indicated that the material is not required on site.

Excavated material which is unsuitable for use in backfill, or surplus excavated material which is not desired by the Owner or the property owner, shall be hauled away and disposed of in an acceptable manner by the Contractor.

There shall be no disposal of materials allowed in the flood way or flood plain. Contractor is responsible for obtaining approval from all applicable agencies and/or property owners for any disposal sites. Copies of all approvals and agreements are to be submitted to the Owner.

3.5 DEWATERING TRENCHES

The Contractor shall be responsible for handling storm water runoff, ground water, and sewage in such a way as to maintain trenches and excavations in a dry condition until the work is completed. Pumps, piping, well points, labor, fuel, and other facilities necessary to control, intercept, remove and/or dispose of water shall be provided at the Contractor's expense.

Water shall be kept out of trenches and other excavations to the extent necessary to protect the supporting strength of the foundation material, permit efficient and

satisfactory assembly or replacement of facilities, and to prevent floating or misalignment.

All water pumped or drained from the work shall be disposed of in a manner satisfactory to the Engineer without damage to adjacent property or to other work under construction. The Contractor shall not dispose of storm or surface water through new or existing sanitary sewerage facilities.

No pipe shall be laid in water, and water shall not be allowed to run over masonry until concrete or mortar has set at least forty-eight (48) hours.

The dewatering of the excavation shall be considered an integral part of the excavation work, and no separate payment will be allowed therefore. Where the Contractor fails, refuses, or neglects to control water in trenches or other excavations, and corrective work is deemed by the Engineer to be necessary as a consequence thereof, such work shall be at the Contractor's expense.

3.6 BRACING, SHEETING, SHORING, AND TRENCH BOXES

- A. The Contractor shall provide such bracing, sheeting, shoring, or trench boxes as may be necessary for the protection of life and property. The Contractor shall be solely responsible for determining when and where to use bracing, sheeting, shoring, or trench boxes in order to protect all employees during the pipe laying operation. The Contractor shall comply with all OSHA and TOSHA standards in determining where and in what manner bracing, sheeting, shoring, or trench boxes are to be used. The Contractor has the sole responsibility for the safety of all employees, the effectiveness of the system, and any damages or injuries resulting from the lack or inadequacy of sheeting, shoring, and bracing. Where excavations are made adjacent to existing buildings or structures or in paved streets or alleys, the Contractor shall take particular care to sheet, shore, and brace the sides of the excavation so as to prevent any undermining of or settlement beneath such structures or pavement. The Contractor shall decide when it is necessary to underpin adjacent structures wherever necessary, with the approval of the Engineer.
- B. Bracing, sheeting, or shoring shall conform to applicable safety codes, and shall be left in place until the pipe is laid, checked, and backfilled to a safe level at or above the top of the pipe. The bracing or sheeting and shoring may then be removed in an approved manner unless the Engineer specifically directs that the sheeting be left in place. Where the sheeting is left in place, either at the direction of the Engineer or option of the Contractor, the sheeting shall be cut off at least eighteen (18") inches below the finished ground level.
- C. The Contractor may use a trench box, which is a prefabricated movable trench shield composed of steel plates welded to a heavy steel frame. The trench box shall be designed to provide protection equal to or greater than that of an appropriate shoring system and shall comply with all OSHA and TOSHA standards.

3.7 FOUNDATION STABILIZATION

After the trench is opened and grade established, it will be examined by the Engineer who will determine whether or not it is satisfactory foundation for pipes and/or appurtenances, or if it is necessary to stabilize the base. The Engineer may order the Contractor to undercut the trench and refill with one to two (1" to 2") inch crushed stone, except that the top six (6") inches of this refill shall be size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction. The stone so placed shall be brought to the subgrade required by the class of bedding for the particular location and compacted.

3.8 BEDDING

Three general classes of bedding for the installation of gravity sanitary sewers in a trench condition are shown on the Standard Detail Drawings and described as follows:

A. CLASS "A" BEDDING

Class bedding shall be a concrete cradle constructed in accordance with the methods shown on the Standard Detail Drawings. Concrete shall be Class "B" and shall be poured to the full width of the trench. Pipe shall be laid to line and grade on concrete blocking, after which the concrete shall be placed to the limits shown.

B. CLASS "B" BEDDING

Class "B" bedding shall be a compacted coarse, granular material placed on a flat bottom trench. The Contractor shall bring the crushed stone bedding up to the required level and shall then shape the bedding to receive the pipe. Bell holes shall be dug so that the bottom of the bells will not support the pipe. Once the pipe is in place, the crushed stone shall be brought up to a minimum of twelve (12") inches above the top of the pipe, thus completing the bedding of the pipe.

C. CLASS "C" BEDDING

Class "C" bedding shall be either a compacted, coarse, granular material placed on a flat bottom trench (Class "C-1"), or a hand shaped subgrade (Class "C-2") constructed in accordance with the methods shown on the Standard Detail Drawings.

Class "C-1" bedding shall be a compacted, coarse, granular material placed on a flat bottom trench. The Contractor shall bring the crushed stone bedding up to the required level and shall then shape the bedding to receive the pipe. Bell holes shall be dug so that the bottom of the bells will not support the pipe. Once the pipe is in place, the crushed stone shall be brought up to a minimum of six (6") inches above the top of the pipe, thus completing the bedding of the pipe.

For Class “C-2”, the Contractor shall hand shape the bottom of the trench to receive the pipe and excavate the bell holes so that the bottom of the bells will not support the pipe. Once the pipe is in place, selected backfill shall be hand placed and tamped up to a minimum of eighteen (18”) inches above the top of the pipe, thus completing the bedding of the pipe.

Special conditions for use of bedding classifications are as follows:

- A. Install gravity sewers on Class “A” bedding only where indicated, specified, or authorized.
- B. Unless otherwise indicated or authorized, all PVC gravity sewer pipe shall be installed on Class “B” bedding.
- C. Unless otherwise indicated, specified, or authorized, all gravity sewer pipe, except PVC pipe, shall be installed on Class “C-1” bedding.
- D. Unless otherwise indicated or authorized, all PVC force main pipe and all ductile iron force main pipe installed in rock trenches shall be installed on Class “C-1” bedding.
- E. Unless otherwise indicated or authorized, all ductile iron force main pipe installed in earth trenches shall be installed on Class “C-2” bedding.

Class “B” concrete to be used in Class “A” bedding shall have a minimum compressive strength of three thousand (3,000) pounds per square inch in twenty-eight (28) days and shall contain not less than five hundred fifty (550) pounds of cement per cubic yard.

The crushed stone material to be used for pipe bedding shall be washed stone provided by a quarry and equal to size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction.

3.9 BACKFILLING

All trenches shall be backfilled immediately after pipes are laid therein and inspected by the Engineer, unless other protection of the pipeline is directed.

Three classes of acceptable backfill material and placement procedures are described as follows:

A. SELECTED BACKFILL

Selected backfill material shall consist of finely divided earth, or other approved material carefully placed about the pipe and up to a height above the top of the pipe barrel as shown on the Standard Detail Drawings for the respective classes of

bedding. Material shall be placed in uniform layers not exceeding nine (9") inches in thickness, each layer thoroughly compacted with proper hand tools in such manner as not to disturb or injure the pipe. Backfilling shall be carried on simultaneously on both sides of the pipe in such manner that injurious side pressures do not occur. If suitable select materials are not available from trench excavation, the Contractor will be required to obtain them elsewhere.

B. GENERAL BACKFILL

After bedding has been placed and tamped, the remainder of the trench may be backfilled with general excavated material, provided no rock which is of dimension no greater than six (6") inches along any axis, shall be used for backfill. Backfill material shall be placed in uniform layers not exceeding nine (9") inches in thickness with each layer thoroughly compacted with heavy duty power tamping equipment of the "Wacker" type, to the full satisfaction of the Engineer. The use of power "Jumping Jack" tampers will not be permitted. At locations outside roads, streets, walks, or other traveled ways open to vehicular or pedestrian travel, the Engineer may waive the requirement of power compaction of backfill upon written request of the Contractor; in which case, after placing the remainder of the backfill up to a level slightly below the natural ground surface, surplus excavation shall be windrowed and maintained in a suitable manner to concentrate and pond surface runoff from rains over the trench; after sufficient settlement has been obtained in the opinion of the Engineer, the Contractor shall complete the dressing, removal of surplus material, and surface cleanup in accordance with the Specifications.

C. CRUSHED STONE

Crushed stone backfill is required for sanitary sewers installed in or across streets, except streets being constructed in new subdivisions, in or across state highways, across drives and other paved or traveled areas. The crushed stone shall be washed stone provided by a quarry and No. 57 or 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction. However, the Tennessee Department of Transportation may require or permit special backfill treatment. Backfill shall be placed in layers or lifts not exceeding twelve (12") inches in thickness. After placing in layers, the stone shall be carefully compacted to maximum density or minimum volume with a vibratory type compactor.

Backfilling around manholes and other structures in streets, state highways, and other paved areas shall also consist of No. 57 or 67's. Backfill around manholes, piers, or other structures in locations not subject to traffic may consist of excavated material subject to the following restrictions:

1. No rock larger than six (6") inches in any dimension shall be placed within six (6") inches of the manhole, structure or pipes entering or leaving the manhole.

2. No rock larger than six (6") inches in any dimension shall be placed in the vertical prism above and extending nine (9") inches outside of the pipelines.
3. Crushed stone shall be used under, around, and over the tops of any pipes entering or leaving the manholes as required by the class of bedding for the pipe of a particular material or at a particular location.
4. Excavated material used for backfill shall be carefully placed in layers and compacted in such manner as to fill all voids and prevent excessive settlement.

D. FINAL GRADING AND TOPSOILING

This shall include the separation and redepositing of topsoil, final grading and raking of all areas disturbed by construction operations across public and/or private property.

Topsoil may be the topsoil originally excavated from the area and separated from the common excavation for redepositing under this item if suitable soils are encountered, or topsoil obtained off the site of the work from other sources by the Contractor and satisfactory to the Engineer. All arrangements and expenses for securing, loading, hauling and spreading topsoil shall be by the Contractor.

The topsoil shall be deposited and spread so that the top 8 inches of the disturbed area is rock free.

The Contractor shall be responsible for and shall protect all sewers, storm sewers and electric, telephone, water, or other pipes or conduits against danger or damage while excavated areas are being backfilled and from future settlement of the backfill. In all instances, sufficient care must be exercised to avoid leaving any holes or voids in trench walls which may later be filled by leaching or settlement of surrounding material thereby causing future trench settlement. Where damage should occur as a result of the Contractor's backfilling operations or from settlement, such damage shall promptly be repaired.

Whenever the trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off, and finally made to conform to the surface of the ground. Backfilling shall be carefully performed, and the original surface restored to the full satisfaction of the Engineer. Surplus material shall be disposed of as directed by the Engineer.

Where excavated material is not suitable for use as backfill material, CONTRACTOR shall provide acceptable backfill material from other sources at no extra cost.

END OF SECTION 02221S

SECTION 02221W

TRENCHING, BEDDING AND BACKFILLING

For

WATER LINES, SEWAGE FORCE MAINS & REPURIFIED WATER LINES

PART 1 – GENERAL

1.1 SCOPE OF WORK

The work covered by this Section consists of loosening, loading, removing, and disposing of, in the specified manner, all wet and dry materials (including rock) encountered that must be removed for construction of waterlines and sewage force mains; furnishing, placing, and maintaining all sheeting, shoring, bracing, and timbering necessary for the proper protection and safety of the work, the workforce, the public, and adjacent property and improvements; the dewatering of trenches and other excavations; the preparation of satisfactory pipe beds; the backfilling and compaction of trenches, foundations, and other structures; the removal of unsuitable material from outside the normal limits of excavation, and where ordered by the Engineering, their replacement with suitable materials; and all other grading or excavation work incidental to or necessary for the work.

1.2 PERMITS AND NOTIFICATIONS

The Contractor shall be responsible for obtaining all the local permits, to include street cut permits, required and for notifying Tennessee One Call to locate all the existing utilities.

PART 2 – PRODUCTS

2.1 NOT APPLICABLE

PART 3 – EXECUTION

3.1 TRENCH EXCAVATION

Trenches shall be neatly excavated to the alignment and depth required for the proper installation of pipe, bedding material, and appurtenances.

The trench shall be excavated to sufficient depth to permit a normal minimum cover of forty-two (42") inches to be maintained over the top of waterlines and sewage force mains. Normal trench depths will be such as to provide for at least this depth of cover and must be even deeper where the existing or adjacent road grade is such that excavation or grading is likely at the trench location. In exceptional cases, with the Engineer's approval, the minimum cover of forty-two (42") inches for waterlines and sewage force mains may be reduced to thirty-six (36") inches. The Contractor's attention is called to

the fact that the thirty-six (36") inch depth of cover for waterlines and for sewage force mains are absolute minimums and may be used only with the Engineer's approval in instances where obstructions or other unusual conditions are encountered in trenching operations. The Contractor will be permitted to lay the pipe above the obstruction only if the minimum cover required can be obtained while providing a separation of at least eighteen (18") inches between the bottom of the pipe and the top of the obstruction. Where this minimum cover and the required clearance cannot be obtained, the Contractor will be required to lay the pipe under the obstruction and will receive no additional compensation for the additional depth of trench required for constructing the line in this manner. The Contractor will also be required to gradually increase the depth of trench when approaching cuts, creek banks, or other changes in grade in order to avoid the use of fittings wherever it is practical to do so and at no additional cost to the Owner.

Trench widths, except in rock when a trenching machine is used, from a point one (1) foot above the top of the pipe down to the bottom of the trench shall be held to a minimum consistent with the provision of necessary space for proper assembly of the pipe. Unless approved otherwise by the Engineer, the trench width, except in rock when a trenching machine is used, must provide a clearance of not less than nine (9") inches in any horizontal direction from all parts of pipe or fittings in the area from the trench bottom to a point one (1) foot above the top of the pipe.

Trench walls shall be kept as nearly vertical as possible with due consideration to soil conditions encountered and in accordance with all OSHA and TOSHA standards. When necessary, sheeting or bracing shall be provided to protect life and property.

The Contractor shall excavate by hand wherever necessary to protect existing structures or utilities from damage or to prevent over-depth excavation in the trench subgrade. The bottom of the trenches, whether in dirt or crushed stone bedding, must be shaped by hand, and bell holes must be dug so that the full length of pipe is resting on trench bottom. Blocking shall not be used, and neither shall the pipe be laid on a trench bottom that has not been leveled to provide support throughout the full length of the pipe.

Should the Contractor excavate below the required depth, the Contractor shall, at no expense to the Owner, bring the excavation to proper grade by filling the void with clean crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction.

Wherever muck, quicksand, soft clay, swampy ground, or other material unsuitable for foundations, subgrade, or backfilling is encountered, remove it and continue excavation until suitable material is encountered. The material removed shall be disposed of in the manner described in paragraph 3.4 Disposal of Materials. Refill the areas excavated for this reason with one to two (1" to 2") inch crushed stone up to the level of the lines, grades, and/or cross sections shown on the Plans. The top six (6") inches of this refill shall be crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction.

Trenches shall be opened up far enough ahead of pipe laying to reveal obstructions, but in general shall not include more than two hundred (200') feet of continuous open trench at

any time. The Contractor will be required to follow up trenching operations promptly with pipe laying, backfill if an inspector is present, and rough cleanup, and in the event of failure to do so, may be prohibited from opening additional trench until such work is completed. This requirement is particularly applicable to work being done in developed areas.

Where trenches cross streets, walks, driveways, and other points as may be directed by the Engineer, the trenches shall be bridged in an open and secure manner, so as to prevent any serious interruption of travel upon the roadway or sidewalks, and also to afford necessary access to public or private premises. No driveways shall be cut or blocked without giving twenty-four (24) hour notice to the occupant of the property. Effort shall be made to schedule the blocking of drives to suit the occupant's convenience, and except in case of emergency, drives shall not be blocked without an alternate access being provided. The material used, and the mode of construction of said bridges and the approaches thereto, must be satisfactory to the Engineer.

3.2 EXCAVATION FOR PIERS, MANHOLES, AND OTHER STRUCTURES

Excavation for piers, manholes, and other incidental structures shall not be greater in horizontal area than that required to allow a two (2') foot clearance between the outer surface of the structure and the walls of the adjacent excavation or of the sheeting used to protect it. The bottom of the excavation shall be true to the required shape and elevation shown on the Plans. No earth backfilling will be permitted under piers, manholes, or similar structures. Should the Contractor excavate below the elevations shown or specified, the Contractor shall, at no cost to the Owner, fill the void with either concrete or clean crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction. Excavation for piers, manholes, and other structures may be performed with nonvertical banks except beneath pavements or adjoining existing improvements.

3.3 EXCAVATION IN SOLID ROCK

Solid rock shall consist of such materials in the original bed or well-defined ledges which, in the opinion of the Engineer, cannot be removed with pick and shovel, trenching machine, backhoe, or other similar devices, and which requires drilling and blasting, or the use of jackhammers or bullpoints. Concrete and masonry structures that require drilling and blasting for removal shall be considered as rock unless otherwise provided for herein. Boulders or detached pieces of rock having volumes of more than nine (9) cubic feet shall also be considered as rock. All rock shall be removed to provide a clearance of not less than nine (9") inches, (eighteen (18") inches when a trenching machine is used), in any horizontal direction from all parts of pipe, fittings, piers, manholes, and other appurtenances.

Excavate rock over the horizontal limits of excavation and to a depth of not less than six (6") inches below the bottom of the structure or pipe. Then backfill the space below grade with crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction, or other approved material, tamp to the proper grade, and make ready for construction.

Where waterlines or sewage force mains are constructed across cultivated fields and pastures, or in streets, excavated rock shall not be mixed with backfill material used to complete the final eight (8") inch layer of backfill at the original ground surface. Surplus rock shall be removed and wasted at points designated by the Owner.

Blasting operations shall be conducted in strict accordance with all existing ordinances and regulations and shall be done only after a pre-blast survey is done at no cost to the Owner by a firm approved by the Engineer. All exposed structures shall be carefully protected from the effects of the blast, and all blasts shall be covered with heavy timbers or other suitable material. The blasting shall be done only by experienced personnel certified by the State of Tennessee Fire Marshal's Office. Any damage done shall be promptly repaired at the Contractor's expense.

Rock excavation in proximity to other pipes or structures shall be conducted with the utmost care to prevent damage to the existing pipes or structures, and any such damage caused shall be promptly repaired at the Contractor's expense. Blasting operations shall not be conducted within ten (10') feet of finished sewer or water pipe.

Extreme care shall be exercised in blasting, with signals of danger given before the firing of any charge. The Contractor shall, in all acts, conform to and obey all rules and regulations for the protection of life and property that may be imposed by any public authorities or that may be made from time to time by the Engineer, relative to the storing and handling of explosives and the blasting operations.

Where rock is encountered in the immediate vicinity of gas mains, telephone cables, building footings, gasoline tanks, or other hazardous areas, the Contractor shall remove the rock by means other than blasting. Care shall be taken in blasting operations to see that pipe or other structures previously installed are not damaged by blasting.

3.4 DISPOSAL OF MATERIALS

Excavated material shall be stored safely away from the edge of the trench and in such a way as to avoid encroachment on private property, danger to workers, utilities, or traffic, and to cause minimum inconvenience through blocking of drives, sidewalks, natural drains, etc.

Any surplus excavated material remaining after the trench backfill has been completed shall be removed from the site by the Contractor. The material may be stockpiled in a suitable location for use in correcting any future trench settlement if it meets the requirements of acceptable backfill. Surplus excavated material may be disposed of in other locations only after the Owner and the property owner have given permission and have indicated that the material is not required on site.

Excavated material which is unsuitable for use in backfill, or surplus excavated material which is not desired by the Owner or the property owner, shall be hauled away and disposed of in an acceptable manner by the Contractor.

There shall be no disposal of materials allowed in the flood way or flood plain. Contractor is responsible for obtaining approval from all applicable agencies and/or property owners for any disposal sites. Copies of all approvals and agreements are to be submitted to the Owner.

3.5 DEWATERING TRENCHES

The Contractor shall be responsible for handling storm water runoff and ground water in such a way as to maintain trenches and excavations in a dry condition until the work is completed. Pumps, piping, well points, labor, fuel, and other facilities necessary to control, intercept, remove and/or dispose of water shall be provided at the Contractor's expense.

Water shall be kept out of trenches and other excavations to the extent necessary to protect the supporting strength of the foundation material, permit efficient and satisfactory assembly or replacement of facilities, and to prevent floating or misalignment.

All water pumped or drained from the work shall be disposed of in a manner satisfactory to the Engineer without damage to adjacent property or to other work under construction. The Contractor shall not dispose of storm or surface water through new or existing sanitary sewerage facilities.

No pipe shall be laid in water, and water shall not be allowed to run over masonry until concrete or mortar has set at least forty-eight (48) hours.

The dewatering of the excavation shall be considered an integral part of the excavation work, and no separate payment will be allowed therefore. Where the Contractor fails, refuses, or neglects to control water in trenches or other excavations, and corrective work is deemed by the Engineer to be necessary as a consequence thereof, such work shall be at the Contractor's expense.

3.6 BRACING, SHEETING, SHORING, AND TRENCH BOXES

- A. The Contractor shall provide such bracing, sheeting, shoring, or trench boxes as may be necessary for the protection of life and property. The Contractor shall be solely responsible for determining when and where to use bracing, sheeting, shoring, or trench boxes in order to protect all employees during the pipe laying operation. The Contractor shall comply with all OSHA and TOSHA standards in determining where and in what manner bracing, sheeting, shoring, or trench boxes are to be used. The Contractor has the sole responsibility for the safety of all employees, the effectiveness of the system, and any damages or injuries resulting from the lack or inadequacy of sheeting, shoring, and bracing. Where excavations are made adjacent to existing buildings or structures or in paved streets or alleys, the Contractor shall take particular care to sheet, shore, and brace the sides of the excavation so as to prevent any undermining of or settlement beneath such structures or pavement. The Contractor shall decide when it is necessary to

underpin adjacent structures wherever necessary, with the approval of the Engineer.

- B. Bracing, sheeting, or shoring shall conform to applicable safety codes, and shall be left in place until the pipe is laid, checked, and backfilled to a safe level at or above the top of the pipe. The bracing or sheeting and shoring may then be removed in an approved manner unless the Engineer specifically directs that the sheeting be left in place. Where the sheeting is left in place, either at the direction of the Engineer or option of the Contractor, the sheeting shall be cut off at least eighteen (18") inches below the finished ground level.
- C. The Contractor may use a trench box, which is a prefabricated movable trench shield composed of steel plates welded to a heavy steel frame. The trench box shall be designed to provide protection equal to or greater than that of an appropriate shoring system and shall comply with all OSHA and TOSHA standards.

3.7 FOUNDATION STABILIZATION

After the trench is opened and grade established, it will be examined by the Engineer who will determine whether or not it is satisfactory foundation for pipes and/or appurtenances, or if it is necessary to stabilize the base. The Engineer may order the Contractor to undercut the trench and refill the areas excavated for this reason with one to two (1" to 2") inch crushed stone up to the level of the lines, grades, and/or cross sections shown on the Plans. The top six (6") inches of this refill shall be crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction. The stone so placed shall be brought to the subgrade required by the bedding for the particular location or pipe material and compacted.

3.8 BEDDING

Bedding for the installation of waterlines and sewage force mains in a trench condition are shown on the Standard Detail Drawings and described as follows:

For all PVC waterlines and sewage force mains, and all ductile iron waterlines and sewage force mains excavated in solid rock, Class "C-1" bedding as shown on the Standard Detail Drawing shall be used. For Class "C-1" bedding, a minimum of six (6") inches of crushed stone shall be placed in the bottom of the trench to maintain the required grade and to provide continuous support of the bottom of the pipe. The Contractor shall bring the crushed stone bedding up to the required level and shall then shape the bedding to receive the pipe. Bell holes shall be dug so that the bottom of the bells will not support the pipe. Once the pipe is in place, the crushed stone shall be brought up to a minimum of six (6") inches above the top of the pipe, thus completing the bedding of the pipe.

Ductile iron pipe may be installed on shaped trench bottoms with shaped bell holes when the trench is excavated in dry, stable earth and is approved by the Engineer. This is Class “C-2” bedding as shown on the Standard Detail Drawings.

The crushed stone material to be used for pipe bedding shall be washed stone provided by a quarry and equal to size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction.

3.9 BACKFILLING

All trenches shall be backfilled immediately after pipes are laid therein, and joints inspected by the Engineer, unless other protection of the pipeline is directed.

Three classes of acceptable backfill material and placement procedures are described as follows:

A. SELECTED BACKFILL

Selected backfill material shall consist of finely divided earth, or other approved material carefully placed about the pipe and up to a height above the top of the pipe barrel as shown on the Standard Detail Drawings for pipe bedding. Material shall be placed in uniform layers not exceeding nine (9”) inches in thickness, each layer thoroughly compacted with proper hand tools in such manner as not to disturb or injure the pipe. Backfilling shall be carried on simultaneously on both sides of the pipe in such manner that injurious side pressures do not occur. If suitable select materials are not available from trench excavation, the Contractor will be required to obtain them elsewhere.

B. GENERAL BACKFILL

After bedding has been placed and tamped, the remainder of the trench may be backfilled with general excavated material, provided no rock which is of dimension no greater than six (6”) inches along any axis, shall be used for backfill. Backfill material shall be placed in uniform layers not exceeding nine (9”) inches in thickness with each layer thoroughly compacted with heavy duty power tamping equipment of the “Wacker” type, to the full satisfaction of the Engineer. The use of power “Jumping Jack” tampers will not be permitted. At locations outside roads, streets, walks, or other traveled ways open to vehicular or pedestrian travel, the Engineer may waive the requirement of power compaction of backfill upon written request of the Contractor; in which case, after placing the remainder of the backfill up to a level slightly below the natural ground surface, surplus excavation shall be windrowed and maintained in a suitable manner to concentrate and pond surface runoff from rains over the trench; after sufficient settlement has been obtained in the opinion of the Engineer, the Contractor shall complete the dressing, removal of surplus material, and surface cleanup in accordance with the Specifications.

C. CRUSHED STONE

Crushed stone backfill is required for sanitary sewers installed in or across streets, except streets being constructed in new subdivisions, in or across state highways, across drives and other paved or traveled areas. The crushed stone shall be washed stone provided by a quarry and No. 57 or 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction. However, the Tennessee Department of Transportation may require or permit special backfill treatment. Backfill shall be placed in layers or lifts not exceeding twelve (12") inches in thickness. After placing in layers, the stone shall be carefully compacted to maximum density or minimum volume with a vibratory type compactor.

Backfilling around manholes and other structures in streets, state highways, and other paved areas shall also consist of No. 57 or 67's. Backfill around manholes, piers, or other structures in locations not subject to traffic may consist of excavated material subject to the following restrictions:

1. No rock larger than six (6") inches in any dimension shall be placed within six (6") inches of the manhole, structure or pipes entering or leaving the manhole.
2. No rock larger than six (6") inches in any dimension shall be placed in the vertical prism above and extending nine (9") inches outside of the pipelines.
3. Crushed stone shall be used under, around, and over the tops of any pipes entering or leaving the manholes as required by the class of bedding for the pipe of a particular material or at a particular location.
4. Excavated material used for backfill shall be carefully placed in layers and compacted in such manner as to fill all voids and prevent excessive settlement.

D. FINAL GRADING AND TOPSOILING

This shall include the separation and redepositing of topsoil, final grading and raking of all areas disturbed by construction operations across public and/or private property.

Topsoil may be the topsoil originally excavated from the area and separated from the common excavation for redepositing under this item if suitable soils are encountered, or topsoil obtained off the site of the work from other sources by the Contractor and satisfactory to the Engineer. All arrangements and expenses for securing, loading, hauling and spreading topsoil shall be by the Contractor.

The topsoil shall be deposited and spread so that the top 8 inches of the disturbed area is rock free.

The Contractor shall be responsible for and shall protect all sewers, storm sewers and electric, telephone, water, or other pipes or conduits against danger or damage while excavated areas are being backfilled and from future settlement of the backfill. In all instances, sufficient care must be exercised to avoid leaving any holes or voids in trench walls which may later be filled by leaching or settlement of surrounding material thereby causing future trench settlement. Where damage should occur as a result of the Contractor's backfilling operations or from settlement, such damage shall promptly be repaired.

Whenever the trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off, and finally made to conform to the surface of the ground. Backfilling shall be carefully performed, and the original surface restored to the full satisfaction of the Engineer. Surplus material shall be disposed of as directed by the Engineer.

Where excavated material is not suitable for use as backfill material, CONTRACTOR shall provide acceptable backfill material from other sources at no extra cost.

END OF SECTION 02221W

SECTION 02600

MANHOLES

PART 1 – GENERAL

1.1 SCOPE OF WORK

The work covered by this Section relates to sanitary sewer manholes including types permitted, components, testing, and installation.

1.2 TYPES PERMITTED

Standard manholes shall be circular in shape and shall be constructed of precast concrete manhole sections in general conformity with the Standard Detail Drawings. No consideration will be given to brick manholes. Poured-in-place manholes and/or bases will be as approved by the Department.

1.3 STANDARDS

Where materials and methods are indicated in the following specifications as being in conformance with a standard specification, it shall refer in all cases to the latest edition of the standard specification and shall include all interim revisions. Listing of a standard specification without further reference indicates that the particular material or method shall conform with such listed specification.

1.4 RELATED WORK SPECIFIED ELSEWHERE

Refer to following Sections of these Specifications for work related to this Section:

- A. Section 02221S – Trenching, Bedding and Backfilling for Sanitary Sewers (Gravity)
- B. Section 02722 – Sanitary Sewers (Gravity)
- C. Section 02724 – Sewage Force Main

PART 2 – PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

Precast concrete manholes shall conform to ASTM Designation C-478, latest revision and the Standard Detail Drawings. All precast, reinforced concrete manhole risers and tops specified herein shall be tested and inspected by a commercial testing laboratory approved by the Engineer prior to delivery to the site, and all materials that fail to conform to these specifications shall be rejected. After delivery to the site, any materials that have been damaged in transit or are otherwise unsuitable for use in the work shall be rejected and removed from the site and shall be replaced at the Contractor's own expense.

Supply certified copies in duplicate of the inspection and acceptance reports of the testing laboratory to the Engineer before using the materials. The commercial testing laboratory shall be engaged and paid for by the Contractor.

2.2 MANHOLE JOINTS

Flexible plastic sealant for joints in precast manhole sections, grade rings and castings shall provide permanently flexible watertight joints, shall remain workable over a wide temperature range, and shall not shrink, harden, or oxidize upon aging. Material shall be butyl resin sealant ConSeal CS-102 or CS-202 as manufactured by Concrete Sealants, Inc. of New Carlisle, Ohio, RUB'R-NEK L-T-M manufactured by K. T. Snyder Co., Inc. of Houston, Texas or **Henry Company**, BIDCO C-56 Joint Sealant manufactured by NPC of Park Hills, MO or other approved equal. A minimum of two (2) strips of joint sealant shall be required at each joint and shall conform to ASTM C990.

Manhole joints shall also be wrapped on the outside and sealed with a 12-inch-wide highly flexible, reinforced, bituminous membrane. A compatible primer shall be used and extend 2 inches each side of the wrap. Material shall be ConSeal CS-212 as manufactured by Concrete Sealants, Inc of New Carlisle, Ohio or approved equal.

2.3 NONSHRINK GROUT

Grout to be used for sealing around sewer pipes at manhole wall penetrations shall be a nonmetallic, nonshrink, flowable grout. The expansion which occurs to compensate for normal hydration shall not create stresses in the pipe or manhole wall. Material shall be premixed and ready to use with only the addition of water required and shall be equal to **Burke nonmetallic grout or SonogROUT as manufactured by the Sonneborn Company.** This applies only to those penetrations where resilient rubber pipe to manhole connections are NOT used.

2.4 RESILIENT PIPE CONNECTIONS AT MANHOLES

Resilient pipe connectors shall be manufactured in accordance with ASTM C-923 and shall consist of a durable rubber boot which shall be clamped securely to the cutout in the manhole wall and to the pipe by means of stainless-steel clamps or bands or cast into the manhole wall. The void area between the pipe and the connector shall be sealed on the inside only to the spring line of the pipe with grout or an approved flexible gasket material such as RUB'R-NEK L-T-M or an approved equal. Resilient connectors shall be as manufactured by the NPC, Inc. KOR-N-SEAL Co. of Milford, New Hampshire, Press-Seal Gasket Corp., PRESS-BOOT of Fort Wayne, Indiana, A-Lok Products of Tullytown, PA or equal.

2.5 BRICK

Brick for repairing existing brick manholes shall be whole, new, hard burned, common building brick, meeting Grade MA of ASTM Specification Designation C32, latest revision. **Brick are no longer acceptable for adjusting manhole castings with new construction, only for repairs for existing infrastructure.** No salmon or soft brick will

be accepted for use. They shall be of reasonable uniform and standard size with parallel edges and square corners. They shall be burned entirely through, free from cracks or flaws, tough and strong, and shall have a clear ring when struck together.

2.6 MORTAR

Mortar for repairing existing manholes, adjusting existing frames and castings or existing manhole inverts shall conform to Section A through F below. Mortar shall also be used to fill in the space between the manhole barrel sections and if there are any voids when the manhole steps are removed. It is not a requirement to fill in the lift holes unless these holes are damaged in some way that would affect the vacuum testing of the manhole.

A. CEMENT

Cement shall be Portland Cement, ASTM C-150, Type II.

B. MASONRY CEMENT

Masonry Cement shall be Brixment, or equal, conforming to ASTM C-91, Type II.

C. SAND

Sand shall be clean, natural river sand. When dry, one hundred (100%) percent of the sand shall pass a number eight (8) sieve, and not more than thirty-five (35%) percent shall pass a number fifty (50) sieve.

D. LIME

Lime shall be either hydrated or quicklime. Hydrated lime to be at least ninety-two (92%) percent hydrated. Quicklime must be able to pass a number twenty (20) sieve.

E. WATER

Water shall be clean and free of deleterious amounts of acids, alkalis, salts, or organic materials.

F. PROPORTIONS

Proportions shall be one (1) part Portland cement, three (3) parts sand, one-fourth (1/4) part lime or one (1) part Portland cement, one (1) part masonry cement, and six (6) parts sand.

2.7 MANHOLE FRAMES AND COVERS

Manhole castings shall conform to ASTM Designation A48, latest revision, Class 30B, and shall be free from scale, lumps, blisters, sand holes, and defects of every nature

which would impair their use. Castings shall be well cleaned. Covers shall be of the solid type. Bearing surfaces of frames and covers shall be machined to provide a solid bearing and prevent rocking. Pattern drawings and weights of castings shall be submitted for the approval of the Engineer.

Manhole frames and covers shall be John Bouchard No. 1150, EJ (East Jordan) 2111 or SIP Industries 5330. Watertight frames and covers shall be John Bouchard No 1123 or approved equal. Submit a certificate from the manufacturer of the castings indicating that they meet all applicable requirements of these specifications.

2.8 MANHOLE STEPS

Manhole steps are permitted in new manholes. There shall only be one top step and it should line up with the others. The steps shall have an overall width of twelve (12") inches, shall be nonskid design, and shall be ductile iron equal to Neenah No. R-1982-F, or injection molded copolymer polypropylene plastic encapsulating a one-half (1/2") inch diameter grade sixty (60) steel reinforcing rod equal to number PS 1 with reflectors as manufactured by M.A. Industries, Inc., Peachtree City, Georgia or Press-Seal Gasket Corp., Fort Wayne, Indiana.

2.9 CONCRETE

Concrete of the respective classes for precast manholes, manhole bases, drop manholes, manhole vents, special manholes, etc. shall conform to the following:

A. CEMENT

Cement shall be Portland cement of a brand approved by the Engineers and shall conform to "Standard Specifications for Portland Cement", Type 1, ASTM Designation C150, latest revision.

B. FINE AGGREGATE

Fine aggregate shall be clean, hard, uncoated sand conforming to ASTM Designation C33, latest revision, "Standard Specifications for Concrete Aggregate".

C. COARSE AGGREGATE

Coarse aggregate shall consist of clean, hard, dense particles of stone or gravel conforming to ASTM Designation C33, latest revision, "Standard Specifications for Concrete Aggregate". Aggregate shall be well graded between one and one-half (1½") inches and number four (4) sieve sizes.

D. WATER

Water used in mixing concrete shall be clean and free from organic matter, pollutants, and other foreign materials.

E. READY-MIX CONCRETE

Ready-mix concrete shall be secured only from a source approved by the Engineers, and shall conform to ASTM Designation C94, latest revision, "Specifications for Ready-Mix Concrete". Before any concrete is delivered to the job site, the supplier must furnish a statement of the proportions of cement, fine aggregate, and coarse aggregate to be used for each mix ordered and must receive the Engineer's approval of such proportions.

F. CLASS "A" CONCRETE

Class "A" concrete shall have a minimum compressive strength of four thousand (4,000) pounds per square inch in twenty-eight (28) days and shall contain not less than six hundred (600) pounds of cement per cubic yard.

G. CLASS "B" CONCRETE

Class "B" concrete shall have a minimum compressive strength of three thousand (3,000) pounds per square inch in twenty-eight (28) days and shall contain not less than five hundred fifty (550) pounds of cement per cubic yard.

H. CORROSION RESISTANT ADDITIVE

Xypex ADMIX C-1000 (dye), BASF Corporation MasterLife 300D or approved equal concrete waterproofing admix shall be added to the concrete during the batching operation to provide corrosion resistance. 3% of the required weight of Portland Cement shall be added as Xypex or BASF. The amount of cement shall remain the same and not be reduced. A colorant shall be added to verify the ADMIX was added to the concrete. Colorant shall be added at the ADMIX manufacturing facility, not at the concrete batch plant. ADMIX must be added to the concrete at the time of batching. It is recommended that the ADMIX powder be added first to the rock and sand and blended thoroughly for 2-3 minutes before adding cement and water.

Blend total concrete mix using normal practices to ensure formation of homogeneous mixture.

PRECAST BATCH PLANT – PAN TYPE MIXER: Add ADMIX to the rock and sand, then mix thoroughly for 2-3 minutes before adding the cement and water. The total concrete mass should be blended using standard practices.

FOR READY-MIX PLANTS – DRY BATCH OPERATION: Add ADMIX to the drum of the ready-mix truck in powder form. Then drive the truck under the batch plant and add 60%-70% of the required water along with 300-500 lb. (136-227 kg) of aggregate. Mix the materials for 2-3 minutes to ensure that the

ADMIX is distributed evenly throughout the mix water. Then add the balance of materials to the ready-mix truck in accordance with standard batch practices.

FOR READY-MIX PLANTS – CENTRAL MIX OPERATION: Mix ADMIX with water to form a very thin slurry (e.g. 15-20 lb. of powder with 3 gallons of water), then pour the required amount of material into the drum of the ready-mix truck. The aggregate, cement and water should be batched and mixed in the plant in accordance with standard practices (taking into account the quantity of water that has been placed in the ready-mix truck). Pour the concrete into the truck and mix for at least 5 minutes to ensure even distribution of the ADMIX throughout the concrete.

2.10 STEEL REINFORCING

Reinforcing bars shall be intermediate grade steel conforming to ASTM Designation A15, latest revision, “Standard Specifications for Billet Steel Bars for Concrete Reinforcement”. Bars shall be deformed with a cross sectional area at all points equal to that of plain bars of equal nominal size.

PART 3 – EXECUTION

3.1 GENERAL

Only the use of precast concrete manholes will be permitted.

A. PRECAST MANHOLES

The Contractor shall submit details of the proposed manholes together with the name of the supplier to the Engineer for approval before any of the precast manholes are shipped to the job site. Precast manholes may be used with precast floors or with structural concrete floors poured-in-place. Precast risers shall be furnished with openings for pipes entering and leaving the manholes. Individual riser sections shall be furnished for the exact conditions to be encountered in the field and shall be constructed so as to suit field conditions and to line up properly with the pipes and manhole steps in other riser sections. The corbel section of the manhole shall be cast in the shape of a concentric cone unless indicated otherwise on the Plans. Misalignment of steps or improperly located holes for incoming pipes shall be cause for rejection of the manhole section. No pipe opening may be enlarged by use of sledgehammer or other impact type tool which could cause structural damage to the riser section. Precast manhole sections shall be joined together in such a way as to present a smooth, uniform joint which shall be structurally sound and watertight (See Part 2-Par2.2). Approved manufacturers of precast manholes are Oldcastle Precast, Inc., Foley Products Company, , Holton Concrete Products, LLC, Hampton Precast Concrete, C.R. Barger & Sons, Jarrett Concrete Products and Vanhooseco Precast, LLC.

B. SPECIAL MANHOLES

Where the size, number, or angle of pipes entering a manhole prevent the use of a standard four through twelve (4', 5', 6', 8', 10', or 12') foot diameter manholes, a

special structure will be required. This special structure shall be built at the locations and in conformance with the details shown on the Plans and the applicable portions of these specifications.

Class "A" concrete shall be used, and reinforcing bars shall be intermediate grade steel conforming to ASTM Designation A15, latest revision, "Standard Specifications for Billet Steel Bars for Concrete Reinforcement".

Three (3) concrete test cylinders shall be made and tested for each separate concrete pour with one (1) being tested at seven (7) and two (2) being tested at twenty-eight (28) days. Sampling of concrete for test purposes shall be per ASTM C-172, latest revision, and testing of specimens shall be per ASTM C-39, latest revision. Testing shall be done by an independent testing laboratory engaged and paid for by the Contractor and approved by the Engineer.

3.2 FLOW CHANNELS

Flow channels for manholes shall consist of smooth, uniform cross sections conforming to the cross section of the pipes so as to provide a minimum of turbulence and avoid deposition of solids. Flow channels shall have a depth at least equal to eight-tenths (0.8) the pipe diameter. The finished floor of the manhole shall have a slope of approximately one-half (1/2") inch from wall to channel to provide for proper drainage, but at the same time offer a safe footing for workers.

3.3 SIZES AND HEIGHTS

Manholes shall be four through twelve (4', 5', 6', 8', 10' or 12') feet in diameter as determined by the pipe sizes and line deflections. Only when previously approved by the Engineer, during the design and where necessary because of height restrictions, a shallow type manhole with a precast concrete cover slab may be used. The maximum height for a shallow type manhole shall be four (4') feet. This vertical centerline height shall be measured from the invert of the outlet pipe to the top of the manhole casting. Above this height, a manhole with a corbel section shall be installed. The access hole cast in the slab shall be located at the center of the slab. Manhole entrances shall be twenty-four (24") inches.

The Contractor shall carefully order the precast manhole sidewall to meet the required field conditions. The height of the unit in place shall be such so as to allow a precast concrete grade ring to be placed on top of the manhole transition section prior to setting the casting.

3.4 DROP CONNECTIONS

Outside drop connections shall be built in manholes at the specified locations and in conformance with the details shown on the Standard Detail Drawing. They are only to be used, when previously approved by the Engineer, during the design and where necessary

because of heavy flows upstream. Where heavy flows upstream do not exist an inside drop bowl shall be installed per the Standard Detail Drawing. The minimum size drop pipe shall be eight (8") inches. Generally, drop pipes shall be one size smaller than the sewer which they serve. Precast outside drop connections shall **not** be used unless otherwise approved by the Department. Where manufactured precast manholes are used, the outside drop must be poured simultaneously with and anchored to the manhole. It is not acceptable for the outside drop to be poured separately and anchored onto the outside of the manhole after curing. It is acceptable to use a precast outside drop manhole utilizing pvc with a ductile iron sewer main extension, only if a rigid coupling is used to transition between pvc and ductile iron. If an outside drop is built and poured in the field, then the pipe material used to build the drop must be of the same material as the mainline sewer. For example, if the sewer main is approved to be ductile iron pipe, then the outside drop must be built from ductile iron pipe as well.

3.5 STUBOUTS

Stub outs for future extensions of the gravity sewer shall be built at the locations and grades shown on the Plans or as directed by the Engineer. Stub outs shall include a resilient pipe connector (see Section 2.4) and a two (2') foot section of plugged pipe installed in accordance with the specifications for bedding and backfilling for the type of pipe being installed as outlined in Section 02221S of these Specifications, Trenching, Bedding, and Backfilling for Sanitary Sewers (Gravity). The invert of the stub out shall be at the elevation shown on the Plans, but the flow channel for the stub out is not to be built in the manhole.

3.6 CONNECTIONS TO EXISTING MANHOLES

At locations where new sewers are shown to be connected to existing manholes, the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations. No bypassing of sewage flows to ditches, streams, storm sewers, or the ground will be permitted. The work shall consist of making the opening in the manhole wall, inserting the new pipe and resilient connector to the elevation shown, constructing necessary drop connections, and remodeling manhole inverts. Openings in the manhole for the pipe shall be cored; the use of hammers will not be permitted. A resilient pipe connector (see Section 2.4) between the manhole and the pipes shall be installed in the cored opening. High-early strength cement shall be used for mortar in order that proper channels may be formed in manhole bottoms with a minimum interruption of service to the existing sewer.

3.7 CONNECTIONS TO NEW MANHOLES

All connections of pipe to new manholes shall be made with resilient connectors. Openings in the manhole sidewall for the pipe shall be precast or cored to provide required size and location. The hole shall be manufactured to allow for lateral and vertical movement, as well as angular adjustments through twenty (20°) degrees. A resilient connector between the manhole and pipes such as Kor-N-Seal or an approved equal shall be installed in the precast or cored opening. The resilient connector shall be molded from an EDPM or polyisoprene compound meeting requirements set forth in

ASTM C923. An external band made entirely of corrosion resistant stainless steel shall be used to affect the seal around the pipe. The void between the pipe and the connector shall be filled on the inside only with grout to the spring line of the pipe or an approved flexible gasket material such as RUB'R-NEK L-T-M or an approved equal.

3.8 VENT PIPE ASSEMBLIES

At locations shown on the Plans or called for by the Engineer, vent pipe assemblies for manholes shall be installed in accordance with the Standard Detail Drawing and as herein specified.

The pipe shall be pressure Class 350 ductile iron pipe, cement mortar lined. Ductile iron pipe and fittings shall be cleaned with surface prep SP-1 (Solvent Clean) and shop primed with one (1) coat (2 to 3 mils) of alkyd-phenolic primer, H.B. Chem-Prime, Tnemec, or approved equal. The finish shall be one (1) coat (2 to 3 mils) of acrylic polyurethane enamel, Endura Shield 74 (gloss) or 75 (semi-gloss), Tnemec, or approved equal. The finish coat of paint shall be dark green.

The vent pipe shall be located as called for on the Plans.

The top of the vent pipe shall not be less than eight (8') feet above the existing ground line or set to the elevation as indicated on the Plans or as determined by the 100-year flood elevation.

Concrete foundation for manhole vent pipe assemblies shall be Class "A" concrete as specified in these Specifications. Forms will not be required unless the foundation is located in backfill materials.

3.9 FOUNDATIONS AND BASES

Dewater sufficiently to maintain the ground water level at or below the bottom of the manhole foundation prior to and during placement of the foundation.

Obtain an adequate foundation for all manhole structures by removing and replacing unsuitable material with well graded granular material, by tightening with coarse rock, or as directed by the Engineer.

Concrete manhole bases may be poured-in-place (must be approved by the Department during the design) or precast with the manhole sidewall conforming to the following requirements:

A. PRECAST MANHOLE BASES

All materials and methods used to precast manhole bases shall conform to the applicable provisions for precast manhole sidewall as set out in these Specifications.

The Contractor shall install the precast concrete manhole base upon a gravel (No. 67, 57, or approved equal) base that is a minimum of six (6") inches thick. This gravel base shall be carefully brought to the required grade. Care shall be taken that the gravel bed is level and even, so that when the precast unit is set in place the manhole sidewall will be installed plumb, and the concrete manhole base is in full contact upon the gravel base.

The precast manhole base shall be a minimum of six (6") inches in thickness.

Backfilling operations, as specified herein, may begin after the installation of the precast manhole sidewall with base has been completed. Upon completion of the backfilling operations, traffic may be allowed on the structure.

B. POURED-IN-PLACE MANHOLE BASES

Poured in place manhole bases must be approved by the Department during the design. Concrete for poured-in-place plain concrete base shall be Class "B" as specified herein.

All concrete shall be adequately protected from injurious action of the sun by keeping it wet, covering with water-saturated cover, or other methods approved by the Engineer.

In cold weather concrete shall be mixed and placed only when the temperature is at forty (40°) degrees F. or above, and rising, unless specifically authorized by the Engineer, in which event all materials shall be heated in a manner approved by the Engineer. In freezing weather, suitable means shall be provided for maintaining the concrete at a temperature of at least fifty (50°) degrees F. for a period not less than seventy-two (72) hours after placing, or until the concrete has hardened. Salt, chemicals, or other foreign materials shall not be mixed with the concrete for the purpose of preventing freezing, unless approved by the Engineer.

The poured-in-place manhole bases shall be allowed to set a minimum of twenty-four (24) hours before installing the manhole sidewall.

The monolithic concrete or the lower section of the precast ring sidewall shall be installed on the manhole base with a bond of cement mortar.

The bond shall be prepared by placing a "bead" of cement mortar, a minimum of three (3") inches thick, upon the manhole base and lowering the sidewall unit onto the mortar. The mortar forced from beneath the sidewall shall not be removed but shall be troweled to the manhole sidewall to form a fillet or chamfer around the base of the sidewall.

Care shall be taken to ensure that the manhole sidewall is installed plumb and truly vertical. To this end the Contractor shall take care, when pouring the concrete manhole base, to finish it to a horizontal surface.

When approved by the Engineer, the manhole sidewall may be set on concrete block supports and the required base poured up to and around the manhole sidewall. The base shall then be allowed to set for twenty-four (24) hours. Care shall be taken to prevent concrete being poured up to or around the resilient pipeline connector.

3.10 WATERPROOFING

This section has been completely omitted due to the water-proofing additive that is mixed with the precast process.

3.11 CASTINGS

Carefully set the cast iron frame for the cover at the required elevation, and properly bond it to the masonry with cement grout and/or anchor bolts. Wherever manholes are constructed in paved areas, tilt the top surface of the frame and cover so as to conform to the exact slope, crown, and grade of the existing adjacent pavement. Whenever manhole castings are set more than two (2") inches above the base/binder because the final surface is to be added later, place, stabilize with sand bags and maintain a drum barricade on the manhole casting as described in the Manual on Uniform Traffic Devices, Part 6.

3.12 BACKFILLING

Place backfill by hand around the manhole and to a distance of at least one pipe length into each trench and tamp with clean crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction, up to an elevation of twelve (12") inches above the crown on all entering pipes. Continue backfilling in accordance with the requirements for trench backfilling.

3.13 TESTING & ACCEPTANCE

It will be required that all manholes be subjected to a vacuum test of at least 10" Hg. prior to acceptance by Murfreesboro Water Resources Department. The test shall be considered acceptable if the vacuum remains at ten (10") inches Hg. or the time to drop to nine (9") inches Hg. is greater than sixty (60) seconds for four (4') foot diameter, seventy-five (75) seconds for five (5') foot diameter, and ninety (90) seconds for six (6') foot diameter manholes.

If the manhole fails the initial test, the Contractor shall locate the leak and make appropriate repairs, acceptable to the Engineer, in preparation for additional tests.

The Contractor will be required to furnish all equipment necessary for this test including the manhole sealing apparatus, gauges, pump, plugs, and operating personnel.

Pre-testing manholes with the casting is acceptable prior to binder being installed and the Inspector is not required to be present. However, final testing for the manholes and castings will not be allowed until binder has been installed along the roadway and around

the casting or the ground is to finished grade outside the proposed roadway. An Inspector must be present during this final testing.

END OF SECTION 02600

SECTION 02722

SANITARY SEWERS (GRAVITY)

PART 1 – GENERAL

1.1 SCOPE OF WORK

The work covered by this Section relates to gravity sanitary sewers and appurtenances including pipe material permitted, installation, testing, and cleanup.

1.2 PIPE MATERIAL PERMITTED

Pipe material for sanitary sewer lines thirty (30") inches and smaller shall be SDR 26 PVC unless it falls under one of the conditions below, in which the pipe material must be coated Class 350 ductile iron:

- A. The sewer main extends between and/or behind existing or proposed lots and/or buildings where the sewer main will be outside of a roadway or in an alley.
- B. The sewer main has greater than or equal to eighteen (18) feet of cover.
- C. The sewer main has less than four (4) feet of cover within a roadway.
- D. The sewer main has less than three (3) feet of cover outside the roadway.
- E. Where sanitary sewer extends underneath a storm drainage pipe thirty-six (36) inches in diameter and larger and/or sanitary sewer and storm drainage does not have eighteen (18) inches of separation between the two. Where this is the case, a casing pipe may be installed the width of the storm crossing plus 10 foot or more either side in lieu of using ductile iron depending on the depth.
- F. Ductile iron may be required in other locations at the Directors discretion.

1.3 PIPE SLOPE PERMITTED

The minimum design criteria for sewer slope are listed within the Tennessee Department of Environment and Conservation's (TDEC) current "Design Criteria for Sewage Works". Exceptions to TDEC "Design Criteria for Sewage Works" are as follows:

<u>Sewer Size (inches)</u>	<u>Minimum Slope (feet per 100 feet)</u>
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12

21	0.10
24	0.08
27	0.07
30	0.06
36	0.05

Under special conditions, slopes slightly less than those required above may be permitted. Whenever such decreased slopes are proposed, the design engineer shall furnish with his report his computations of the depths of flow in such pipes at minimum, average, and daily or hourly rates of flow. Sewer on 18 percent slope or greater shall be anchored securely with concrete anchors at every joint. See details for specifications on the anchor.

1.4 STORAGE OF MATERIALS

The Contractor shall be responsible for safely storing materials for the work until they have been incorporated into the completed project. Keep the interiors of all pipes, fittings, and other accessories free from dirt and foreign matter at all times.

1.5 DEFECTIVE MATERIALS

It shall be the Contractor's responsibility to ensure that all necessary materials are furnished and that those found to be defective in manufacture are replaced at no extra cost to the Owner. Materials damaged in handling after being delivered by the manufacturer shall be replaced at the Contractor's own expense. If installed material is found to be defective before the final acceptance of the work, the cost of both the material and labor needed to replace it shall not be passed on to the Owner.

1.6 RELATED WORK SPECIFIED ELSEWHERE

Refer to following Sections of these Specifications for work related to this Section:

- A. Section 02221S – Trenching, Bedding and Backfilling for Sanitary Sewers (Gravity)
- B. Section 02600 – Manholes
- C. Section 03303 – Concrete for Water Lines, Sanitary Sewer Mains and Repurified Water Lines and Appurtenances

1.7 STANDARDS

Where materials and methods are indicated in the following specifications as being in conformance with a standard specification, it shall refer in all cases to the latest edition of the standard specification and shall include all interim revisions. Listing of a standard specification without further reference indicates that the particular material or method shall conform with such listed specification.

All materials to be incorporated in this project shall be first quality, new, and undamaged material conforming to all applicable portions of these specifications. Where deviation

from the specifications is necessary because of changes in manufacturing procedures, inability to obtain the specified product, or other extenuating circumstances, a request for the proposed substitution shall be submitted to the Engineer in writing for consideration. Materials failing to conform to these specifications shall not be delivered to the job site unless the Contractor has written approval from the Engineer covering the substitute materials.

PART 2 – PRODUCTS

2.1 GENERAL PIPE REQUIREMENTS

A. QUALITY AND INSPECTION

Latitudes in workmanship and finish allowed by ASTM Specifications notwithstanding, all pipe shall be first quality, of smooth exterior and interior surfaces, free from cracks, blisters, and other imperfections, and true to theoretical shapes and forms throughout each length. All pipe, independent of laboratory tests, shall be subject to the inspection of the Engineer at the pipe plant, trench, or other point of delivery for the purpose of culling and rejecting pipe which does not conform to the requirements of these Specifications. Pipe which does not conform shall be marked as such by the Engineer and/or Inspector and shall not be delivered or used in the work. Repairing of rejected pipe will not be permitted. **The supplier must provide and deliver pipe manufactured by one company per project/job only. The mixing of different pipe manufacturers will no longer be accepted. Jobs can be broken into separate sections and/or phases as approved by the Murfreesboro Water & Sewer Department.**

B. EXPERIENCE OF MANUFACTURER

The manufacturer of the pipe shall submit evidence, if requested by the Engineer, of having consistently produced both pipe and joints of specified quality and satisfactory performance results in service over a period of at least two years. The manufacturing process shall be subject to the approval of the Engineer.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

A. MATERIAL

PVC sewer pipe shall be **SDR 26** sewer pipe as specified in the “Standard Specification for Type PSM PVC Pipe and Fittings”, ASTM Designation D3034, latest revision (for sizes 4”-15” diameter) and as specified in the “Standard Specification for PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings”, ASTM Designation F679, latest revision (for sizes 18”-27” diameter). The pipe shall be highly resistant to hydrogen sulfide, sulfuric acid, gasoline, oil, detergents, and other chemicals found in sewage and industrial wastes.

B. JOINTS

Joints shall be push-on compression type joints utilizing elastomeric gaskets manufactured in conformance with ASTM F477, latest revision. Design of joint shall be such as to allow deflection of up to three (3°) degrees without affecting the hydraulic seal of the joint, and shall also be such that the joint will not open up even with the gaskets on the opposite side compressed to the maximum.

C. TESTING

All testing of PVC sewer pipe fittings and joints shall be performed in accordance with ASTM F477, ASTM D3034 and ASTM F679 latest revisions.

D. MARKING

All pipe and fittings delivered to the job site shall be marked in accordance with ASTM D3034 or ASTM F679 latest revision.

E. CERTIFICATIONS

Manufacturer shall furnish certifications as follows:

1. That the materials used in the manufacture of the pipe and the elastomeric gaskets conform to ASTM D3034, ASTM F477 and ASTM F679 latest revisions.
2. That the pipe and elastomeric gaskets were manufactured and tested in conformance with ASTM D3034 and ASTM F477 and ASTM F679 latest revisions.
3. Date of manufacture of pipe.

In addition to the certification to be furnished by the manufacturer, the Owner may retain an independent testing laboratory to sample, test, and inspect one (1%) percent of the production of each size pipe furnished for this project. The Owner will bear the expense for the test specimens, which shall be randomly selected by the testing laboratory, or other designated representative of the Owner, from the pipe on the manufacturer's yard which has been inspected and designated for shipment to the project.

F. LENGTHS

Pipe shall be furnished in lengths not less than ten (10') feet or more than fourteen (14') feet.

G. MANUFACTURERS

Pipe shall be manufactured by JM-Eagle Manufacturing, Vulcan, NAPCO, Diamond, National, Sanderson Pipe (Vinylplex), Royal Building Products, Pipelife Jet Stream, Inc., or approved equal.

2.3 DUCTILE IRON PIPE

A. MATERIAL

Ductile iron sewer pipe shall conform to ANSI/AWWA Specification C151/A21.51, latest revisions, for ductile iron pipe centrifugally cast in metal or sand lined molds. Pipe shall have asphaltic coating on the exterior. Pipe shall have an interior lining of coal tar epoxy, amine cured novalac epoxy containing ceramic quartz pigment, or polyethylene lining. Pipe shall be made with 60-42-10 grade ductile iron, or stronger, and pressure Class 350 shall be used unless noted otherwise on the Plans.

B. JOINTS

Joints shall be push-on type compression joints unless otherwise indicated and shall conform to ANSI/AWWA/C111/A21.11, latest revisions. Gaskets and lubricant shall be furnished with the pipe.

C. TESTING

Testing of ductile iron pipe and joints shall be performed in accordance with ANSI/AWWA/C151/A21.51 and ANSI/AWWA/C111/A21.11, latest revisions.

D. MARKING

The weight, pressure, class, manufacturer's mark, year of manufacture and letters "DI" or "DUCTILE" shall be cast or stamped on pipe.

E. CERTIFICATIONS

Manufacturer shall furnish certifications as follows:

1. That the pipe and joints have been manufactured in accordance with ANSI/AWWA/C151/A21.51 and ANSI/AWWA/C111/A21.11, latest revisions.
2. The pipe and joints have been tested in accordance with the procedures and outlined in ANSI/AWWA/C151/A21.51 and ANSI/AWWA/C111/A21.11, latest revisions.

- F. Pipe shall be furnished in lengths of eighteen (18') feet or sixteen (16') feet except for special construction conditions.

G. INTERIOR COATING FOR DUCTILE IRON PIPE

The pipe manufacturer shall submit complete information on the proposed coating system, method of application and application personnel to the Engineer and shall receive the Engineer's approval before undertaking any pipe coating. Certified copies of the manufacturer's testing results shall also be submitted to the Engineer by the pipe manufacturer.

In addition to the certifications to be provided by the pipe manufacturer, the Owner may retain an independent testing laboratory to inspect and label the pipe before the coating application begins. If so directed, the independent testing laboratory provided by the Owner will make random selections of up to one (1%) percent of the coated pipe sections which will be visually inspected, checked for holidays, and tested for dry film thickness. Any patching or re-coating of the test sections shall be done by the Applicator at no additional cost. Any changes in procedure or any re-coating necessary to correct defective coating systems shall be carried out promptly upon notification of such deficiencies.

1. Interior coating for ductile iron pipe shall consist of a coal tar epoxy lining system applied in strict accordance with the coating manufacturer's recommendations and these Specifications. The coating shall be equivalent to Kopcoat 300-M or Tnemec 46H-413 Hi Build Tneme – Tar.
2. Cured novalac epoxy lining for ductile iron pipe shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Lining shall be forty (40) mils nominal thickness.
3. Polyethylene lining for ductile iron pipe shall be of virgin polyethylene complying with ASTM D-1248 compounded with sufficient lamp black to resist ultraviolet rays during above ground storage of the pipe. Lining shall be heat fused to the interior of the pipe and shall be approximately forty (40) mils thick.

H. MANUFACTURERS

Pipe shall be manufactured by U.S. Pipe/Griffin Pipe & Foundry Co., American Cast Iron Pipe Co., McWane Pipe/James B. Clow & Sons, or approved equal.

2.4 FITTINGS AND SERVICE LINES

Fittings, service lines, and jointing material, unless otherwise directed by the Engineer, shall be in conformance with the requirements of the specifications for that portion of the main sewer where installed. Mechanical and/or push-on type fittings may be used on short sections of ductile iron gravity sewers if approved by the Engineers. Ductile iron fittings shall have interior lining and exterior coating as specified for pipe with which they are used. Fittings shall be field assembled in conformance with the manufacturer's directions. Ductile iron compact fittings shall conform to ANSI A21.53.

Ductile iron gravity sewers shall not be connected to PVC gravity sewers except by means of a manhole or by other methods approved by the Engineer.

PVC sewer fittings shall be manufactured by GPK Products, Inc., Multi Fittings, Plastic Trends, Inc. (PTI), HARCO, TIGRE, or approved equal.

Ductile iron sewer fittings shall be manufactured by Tyler/Union Foundry, U.S./Griffin Pipe, American, McWane/Clow, Sigma, Star, SIP Industries or approved equal.

2.5 CASING PIPE

The minimum material requirements for casing pipe used in highway and railroad crossings shall be steel conforming to ASTM A139, Grade B. Minimum yield strength shall be 35,000 psi. All casing pipe used must meet the approval of the permitting authority. If the casing pipe is being used in a bore situation within the City's rights-of-way, the bore must extend to 10 feet beyond the toe of the slope and/or the back of the ditch and at minimum from right-of-way to right-of-way. **If the sewer main must bore underneath a roadway, stream, CSX Railroad, etc,** the nominal casing diameter shall be as indicated on the plans as determined by the Department but shall be **2.5** times larger than the diameter of carrier pipe minimum. Otherwise, if the sewer main is installed in an open-cut situation, it is approved for the casing to be 2.0 times larger than the diameter of the carrier pipe minimum. Joints shall be continuously welded. Casing pipe and joints shall be leakproof and capable of withstanding Cooper E-80 loading. Casing pipe shall be coated as specified herein.

The minimum wall thickness of casing pipe shall be as shown in the table below:

Nominal Diameter (Inches)	Minimum Wall Thickness (Inches)	
	<u>With Coating</u>	<u>Without Coating</u>
Under 14	0.188	0.251
14 and 16	0.219	0.282
18	0.250	0.313
20	0.281	0.344
22	0.312	0.375
24	0.344	0.407
26	0.375	0.438
28 and 30	0.406	0.469
32	0.438	0.501
34 and 36	0.469	0.532
38, 40, 42	0.500	0.563

Where specified, coating for steel casing pipe shall be a two component, self-priming, chemically cured coal tar epoxy-polyamide protective coating. Minimum dry film thickness of completed coating shall be sixteen (16) mils. Material shall be Kopcoat 300 M, Tnemec 46H-413 Hi Build Tneme – Tar or equal. Preparation shall be SP6 commercial blast.

2.6 CONCRETE

A. CLASS "A" CONCRETE

Class "A" concrete shall have a minimum compressive strength of four-thousand (4,000) pounds per square inch in twenty-eight (28) days and shall contain not less than six-hundred (600) pounds of cement per cubic yard.

B. CLASS "B" CONCRETE

Class "B" concrete shall have a minimum compressive strength of three-thousand (3,000) pounds per square inch in twenty-eight (28) days and shall contain not less than five-hundred-fifty (550) pounds of cement per cubic yard.

2.7 CHECK DAMS

Consists of Class "B" Concrete as listed in 2.6.B.

A. REQUIRED DIMENSIONS

1. 1 foot thick along pipeline.
2. Key 2 feet into trench wall (each side) except in rock where dam shall be against rock/trench wall.
3. Depth – From bottom of trench to 12" above gravel envelope.

PART 3 – EXECUTION

3.1 GENERAL

Prior to construction, the Contractor is responsible for obtaining coverage under the State's Construction General Permit and City Land Disturbance, in cases where the disturbed area covers more than an acre; and for implementing erosion and sediment controls as required.

The Contractor will be held completely responsible for any damage to pavement, sidewalks, curbs, gutters, meter or valve boxes, street inlets, poles and guy wires, existing sewer mains and manholes or other structures or appurtenances as a result of construction operations. This damage shall include filling the existing downstream sections of sewer main with debris, mud etcetera. The contractor shall install a watertight plug in the existing main directly downstream of the connection at the start of construction to avoid the above. It should be specifically noted that the Contractor shall be responsible for damage even though the character or nature of the original pavement or structure was such that it was not capable of carrying the load of the construction equipment regardless of the construction methods used.

The Contractor shall take precautions as may be necessary to avoid endangering personnel, pavement, adjacent utilities, or structures through cave-ins, slides, settlement, or other soil disturbances resulting from construction operations. The Contractor shall furnish and maintain barricades, signs, flashing lights, and other warning devices as necessary for public safety and as required by the Manual on Uniform Traffic Control Devices, Part 6.

The Contractor shall plan construction operations so as to cause a minimum of inconvenience to property owners and to traffic. Flaggers shall be provided as required on heavily traveled streets to avoid traffic jams or accidents. No road, street, or alley may be closed unless absolutely necessary, and then only if the following conditions are met:

- A. Permit is secured from appropriate State, County, or Municipal authorities having jurisdiction.
- B. Fire and Police Departments and other emergency services are notified before road is closed.
- C. Suitable detours are provided and are clearly marked.

No driveways shall be cut or blocked without giving twenty-four (24) hour notice to the occupant of the property. Every effort shall be made to schedule the blocking of drives to suit the occupant's convenience, and except in case of emergency, drives shall not be blocked without an alternative access being provided.

Whenever pipe laying operations are to be discontinued for an extended period of time, the end of the pipe shall be carefully secured to avoid displacement or misalignment, and a tight-fitting plug or stopper shall be placed in the line. Upon resumption of laying operations, the plug or stopper shall not be removed from the line until any water, mud, or other debris has been removed to avoid entry into the completed section of the sewer.

Installation of sewer pipe shall conform to provisions of these specifications and recommendations of the pipe manufacturer. Installation instructions provided by the pipe manufacturer shall be available at all times at the location of the work.

The proper gaskets and lubricants shall be furnished by the pipe manufacturer, and lubricants shall be delivered to the job site in properly labeled, unopened containers.

Wye branches and other fittings shall be placed in the sewer line as shown on the Plans or as directed by the Engineer as pipe laying progresses. The Contractor shall keep accurate records of their location.

When sewer lines are to be constructed near water mains, horizontal and vertical separation shall be maintained as described below:

Horizontal Separation: Whenever possible, sewers should be separated horizontally from water mains a minimum of ten (10') feet. If this is not possible,

the lines may be laid closer provided they are in separate trenches, and if the elevation of the top of the sewer is at least eighteen (18") inches below the bottom of the water main.

Vertical Separation: When a sewer line must cross a water main, the top of the sewer should be at least eighteen (18") inches below the bottom of the water main.

If the elevation of the sewer cannot be varied to meet the above requirements, relocate the water main to provide this separation, or else reconstruct it with mechanical joint ductile iron pipe for a distance of ten (10') feet on each side of the sewer with a full joint of the water main centered on the sewer. If it is impossible to obtain proper horizontal and vertical separation as stipulated herein, construct both the water main and the sewer of mechanical joint ductile iron pipe and pressure test each.

The Contractor shall submit a proposed construction schedule for the Engineer's approval before construction begins. If the sewer is to be installed in a proposed road, the road shall be graded to +/- one (1) foot from subgrade before the sewer is installed. The normal requirement will be to begin pipelaying at the lower end of any proposed line and continue laying upstream until the line is completed. Construction will begin at points where proposed sewers tie into existing sewers, existing or proposed pump stations, or existing or proposed treatment facilities.

3.2 PIPE INSTALLATION

All grade and alignment stakes shall be set and cut sheets prepared for installation of gravity sewers in accordance with the following procedures for the two (2) types of projects for which these specifications apply:

A. PROJECTS BEING CONSTRUCTED WITH PUBLIC FUNDING UNDER CONTRACT TO THE DEPARTMENT

1. General

The Contractor shall be responsible for setting all grade stakes, lines and levels and preparation of cut sheets. The Contractor shall provide level, level rod and tripod on the job site at all times for the purpose of checking grades, as deemed necessary by the Engineer. All grade and alignment stakes for construction under this project shall be set by a land surveyor registered to practice in the State, and all costs thereof shall be borne by the Contractor. Registered land surveyor may be waived by the Engineer in the event the Contractor desires to utilize his own personnel who are qualified to set the grade and alignment stakes. The Contractor shall assume all responsibility for the correctness of the grade and alignment stakes.

The Contractor may use batter boards or a properly calibrated beam device. No claim for extra work will be allowed for alleged inaccuracy of the laser beam device. Grade hubs for laser beams shall not exceed 100 feet apart with centerline hubs every 50 feet to check laser and grade between manholes.

If the Contractor elects to use batter boards, he shall provide and maintain the work at all times a gauge rod of sufficient length to reach from the invert of the sewer pipe being laid to the top line strung on the three batter boards. The gauge rod shall be graduated and numbered each foot of its entire length. The gauge rod shall be equipped with either a plumb line or two spirit levels and the utmost care used to insure a truly vertical gauge rod at the time a reading is taken and pipe is being set.

One week prior to the commencement of trench excavation, the Contractor shall prepare and submit to the Engineer for review four (4) copies of detailed Cut Sheets showing the beginning and ending manholes; the distance between manholes; the grade, size and type of line; the depth of cut; etc. The form of Cut Sheet shall be provided to the Contractor. All expense for the preparation of Cut Sheets shall be borne by the Contractor and be included in the unit price bid per foot of pipe.

Cut Sheets must be reviewed by the Engineer in writing before trenching operations may be permitted. It shall be the responsibility of the Contractor to prepare Cut Sheets (one week) in advance of his anticipated trenching schedule.

B. PROJECTS BEING CONSTRUCTED WITH PRIVATE FUNDING UNDER THE DEVELOPMENTAL PROCEDURES OF THE DEPARTMENT

1. General

The sewer shall be staked and the cut sheets prepared by the Developer's Engineer and/or by a Registered land surveyor. This requirement may be waived by the Department, at the discretion of the Director, in the event the Contractor desires to utilize his own personnel who are qualified to set the grade and alignment stakes. The cut sheet stationing must match the stationing on the approved construction drawings. Three (3) copies of the cut sheets shall be given to the Department for review and approval; the Department will provide the Developer's Contractor with the cut sheets.

In addition to the sewer cut sheets, the Contractor must submit his license and insurance to the Department for review and approval as per the Policies, Procedures and General Design Requirements, prior to the Department issuing a notice to proceed.

The trench for the sewer pipe, including the bottom, bedding, sides, backfilling, and any necessary foundation stabilization, dewatering,

sheeting or shoring, and the disposal of materials shall be prepared or done in accordance with Section 02221S, Trenching, Bedding, and Backfilling for Sanitary Sewers (Gravity).

The Contractor shall exercise care in the storage and handling of pipe, both on the storage yard and at the site of laying operations. Suitable clamps, slings, or other lifting devices shall be provided for handling pipe and fittings. Pipe and fittings shall be carefully lowered into the trench piece by piece. AT NO TIME SHALL A SECTION OF PIPE BE ROLLED OR DROPPED FROM A TRUCK OR INTO THE TRENCH. Pipe and fittings shall be inspected for defects and for dirt or other foreign material immediately before placing them in the trench. Suitable swabs shall be available at the site for laying operations, and any dirt or foreign material shall be removed from the pipe before it is lowered into the trench.

Alignment and grade shall be carefully maintained during the laying operations. The method used for maintaining grade and alignment must be acceptable to the Engineer and to the Owner. If the Contractor elects to use batter boards, they shall provide and maintain the work at all times a gauge rod of sufficient length to reach from the invert of the sewer pipe being laid to the top line strung on the three batter boards. The gauge rod shall be graduated and numbered each foot of its entire length. The gauge rod shall be equipped with either a plumb line or two spirit levels and the utmost care used to insure a truly vertical gauge rod at the time a reading is taken and pipe is being set. If the Contractor elects to use laser beams, they must set reference points for both line and grade at each manhole. Where grades are 0.6% or less, check the elevation of the beam each one hundred (100') feet with an offset point or engineer's level. Laser beams shall be used in accordance with manufacturer's instructions.

Each pipe shall be laid on an even, firm bed, so that no uneven strain will come to any part of the pipe. Particular care shall be exercised to prevent the pipes bearing on the sockets. Bell holes for bell and spigot pipe shall be dug at each point as hereinbefore specified. The bell-end of the pipe shall be laid upgrade.

Each pipe shall be laid in the presence of an Inspector where possible. If an Inspector cannot be present while the pipe is being laid, the Contractor may go ahead and lay the pipe but not backfill the trench until the Inspector has inspected the pipe. If the Contractor has laid and "safed up" two hundred (200') feet of pipe without the Inspector being present, the Contractor must lay no more pipe until the Inspector has inspected the pipe that has already been laid and given permission to backfill the pipe and to proceed with laying pipe. The laying of the pipe with an Inspector being or not being present does not relieve the Contractor of the responsibility to install the pipe in accordance with the Specifications.

INSTALLATION SPECIFICATIONS:

A. PVC PIPE

Installation of the pipe shall be in strict accordance with ASTM Designation D-2321, Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe. Due precautions must be taken in placing the bedding under the pipe haunches and on the sides of the pipe to insure proper support of the pipe and at the same time avoid any misalignment. Attention is called to the provisions by these specifications which limit pipe diametric deflection to five (5%) percent.

After the pipe has been placed and brought to grade, the pipe shall be held in place while crushed stone is carefully worked in around the pipe for firm support of bottom and sides. Extreme care shall be taken in backfilling around the pipe to avoid raising the pipe above the grade line but at the same time provide the required support. The crushed stone shall be placed in small quantities and distributed by hand up to a point twelve (12") inches above the top of the pipe.

B. DUCTILE IRON PIPE

Unless otherwise indicated, ductile iron pipe shall be laid with slip type compression joints, equal to the manufacturer's standard for pressure water pipe, and assembly of the joints shall be in accordance with the manufacturer's recommendations using lubricant and accessories as provided by the pipe manufacturer.

Whenever it is necessary to cut a joint of pipe in order to fit the trench conditions, the cutting shall be done using the equipment as recommended by the manufacturer for the specific type of pipe involved. The cut shall be made so as to leave a smooth end at right angles to the axis of the bore, and the end shall be bevelled or finished as required to make the joint without risk of damage to gasket.

3.3 CHECK DAM INSTALLATION

Check dams shall be installed in the trench of new, replaced, or rehabilitated gravity sewer lines. The location of these check dams shall be as given below:

1. 15 feet upstream of each manhole where manholes are spaced between 250 and 400 feet apart.
2. 10 feet upstream of every other manhole where manholes are spaced 250 feet apart or less.
3. Where the gravity sewer line crosses a stream/creek, dams shall be installed on each side.

3.4 CLEANING, TESTING, AND ACCEPTANCE

A. GENERAL

Before acceptance of any sewer or system of sewers, lines shall be cleaned and tested to the satisfaction of the Engineer. Cleaning is not defined as washing mud and debris downstream into the existing system. The lines must be cleaned and the cleaning water and debris pumped from the lines and/or manholes to the satisfaction of the Department. Where any obstruction is met, the Contractor will be required to clean the sewers by means of rods, swabs, or other instruments. Lines and manholes shall be flushed and washed down before final inspection, at the request of the Engineer. Pipelines shall be straight and show a uniform grade between manholes, and the Contractor will be required to correct any variations therefrom which may be discovered during the inspection. No final inspection will be scheduled by the Engineer until the Contractor has conducted an inspection and believes the project to be ready for such final inspection. After all apparent defects have been corrected, the Contractor shall notify the Engineer and/or Inspector and request a final inspection. All underground conduit and utilities (Storm drainage, Water Mains, Murfreesboro Electric, Middle Tennessee Electric, Atmos Energy, Cable, etc) shall be installed prior to testing. Should the Engineer begin a final inspection at the request of the Contractor and find that the sewers have not been cleaned or defects have not been corrected, the inspection will be terminated and will not be rescheduled until the Contractor again advises that the project is ready for inspection.

Acceptance of the project shall involve visual inspections, video inspections and leakage tests. The procedures shall be as outlined hereinafter. The work will not be accepted until the visual inspection, video inspection and leakage test results are satisfactory.

B. VISUAL INSPECTION AND MANDREL

The Engineer will, as a part of the final inspection, make the necessary visual inspections to verify the quality of workmanship. Such inspections shall include examination of manholes, “lamping” or “flashing” sewer lines, and observation of cleanup, pavement replacement, etc.

Any defects such as sags, humps, bends, or other evidence of misalignment of sewers, visible leaks, obstructions, cracked or broken pipe, or failure to restore the surface to a satisfactory condition must be corrected to the Engineer’s satisfaction before acceptance.

Sewers constructed of flexible PVC pipe will be checked for roundness. The Contractor shall provide a suitable rigid ball or 9-arm mandrel having a diameter equal to ninety-five (95%) percent of the inside pipe diameter which shall be pulled through the sewer. This test cannot be performed any sooner than thirty (30) days after each segment of the sewer main within a section or phase, has been laid and backfilled. This test must also wait until all other underground utilities have been installed. The contractor may decide to mandrel the lines before the thirty (30) days has expired for his own knowledge as to whether the

sewer main was laid correctly or has any defects however, this will not release him of the test required after the thirty (30) days unless otherwise approved by the Director. Any section of the sewer showing a deflection of more than five (5%) percent shall be relaid to correct the condition.

C. LEAKAGE TESTS

The Contractor shall provide suitable equipment for making air pressure tests and for measuring infiltration.

Air pressure tests shall be made between adjacent manholes for all sections of sewers laid with ductile iron and/or PVC sewer pipe. This test cannot be performed any sooner than thirty (30) days after each segment of the sewer main, within a section or phase, has been laid and backfilled. This test must also wait until all other underground utilities have been installed. The contractor may decide to test the lines before the thirty (30) days has expired for his own knowledge as to whether the sewer main was laid correctly or has any defects however, this will not release him of the test required after the thirty (30) days unless otherwise approved by the Director.

Procedure for air testing shall be as specified in UNI-BELL UNI-B-6 and as follows:

1. After sewer has been cleaned, test plugs shall be inserted at end of test section. Plugs shall be suitably braced or blocked.
2. Air should be slowly added to the plugged section until a pressure of 4 psi is reached. At least two minutes should be allowed for temperature stabilization.
3. With the air pressure at 4 psi disconnect the air supply.
4. When air pressure drops to 3.5 psi begin timing with a stopwatch and determine time required for pressure to drop to 2.5 psi.
5. Required test times for various pipe diameters are shown in the following table.
6. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test. If a 1.0 psi drop does not occur within the test time, the line has passed the test.

<u>Pipe Diameter</u>	<u>Minimum Test Time (Min;Sec)</u>	<u>Pipe Length for Min. Time (ft)</u>	<u>Test Time for Longer Lgth (Sec)</u>
4"	3:46	597	0.380 L
6"	5:40	398	0.854 L
8"	7:34	298	1.520 L
10"	9:26	239	2.374 L

12"	11:20	199	3.418 L
15"	14:10	159	5.342 L
18"	17:00	133	7.692 L
21"	19:50	114	10.470 L
24"	22:40	99	13.674 L
27"	25:30	88	17.306 L
30"	28:20	80	21.366 L

Where the ground water table is known to be above the sewer, all pressures shall be raised by an amount equal to the ground water pressure (0.4 psi per foot of water). The air pressure test may be made with the pipe in a dry or normal condition, but in the event the section fails to pass the test, the Contractor will be permitted to repeat the test after having soaked the pipe to produce moisture saturation. Caution should be exercised to avoid overpressuring the sewer and to avoid blowing out of test plugs. No one should be permitted to enter an adjacent manhole while a section of sewer is under test.

Where the natural ground water is twenty-four (24") inches or more above the top of a section of pipe, measure the flow of water in the pipe and the rates of seepage and infiltration. Measure the flow rate by using a calibrated weir. Leave the weir in the line until the flow rate has stabilized. The Contractor is responsible for verifying the ground water level by providing sight gauges in manholes or digging test holes in suitable locations. The infiltration observed in any section of sewer less than thirty (30") inches in diameter shall not exceed twenty-five (25) gallons per inch of pipe diameter per mile of line per day. No measurable infiltration will be acceptable in ductile iron pipe.

All visible leaks in pipes and manholes must be corrected regardless of amount of infiltration. The repair or replacement of all defective materials shall be done at the Contractor's expense.

The Contractor shall furnish all equipment and personnel for making the above-described tests, but the tests shall be made at a time acceptable to the Engineer/Inspector and shall be witnessed by the designated representative of the Engineer/Inspector.

D. VIDEO

The sewer lines and services are required to undergo a PACP compliant closed-circuit television inspection prior to acceptance of the project into the warranty period. The video portion of the testing also has the same thirty (30) day waiting period as stated above for the mandrel and leakage tests. Any existing sewer mains that are connected to or any mains that are crossed by a proposed utility will be required to undergo a PACP compliant closed-circuit television inspection prior to acceptance of the project as well. This work will be performed by a third party PACP certified contractor at the expense of the Developer and/or his Contractor and will take place after all other tests have been performed but prior to the start of the warranty period. This video is to be submitted to the Department for review. If any defects are noted from this video, the contractor

will be required to resolve these defects and perform all of the required testing again prior to acceptance. Refer to the latest revision of the CCTV Specifications for video requirements.

3.5 CONNECTIONS AND APPURTENANCES

A. CONNECTIONS TO EXISTING SYSTEM

No new sewer lines shall be available for use until all new upstream construction has been completed, is free of foreign materials, and obvious defects have been corrected. New lines must remain disconnected from the existing system by actual physical separation, by plugs or other means approved by the Department.

New sewer connections with old existing sewers shall be made within a manhole. Where an old manhole exists at the point of connection of new and old sewers, it shall be core drilled, a rubber boot installed, be repointed, and any loose bricks or blocks in the walls of the old existing manhole shall be relaid. The Contractor shall reconstruct the invert of the manhole to accommodate the new connection. At locations where new sewers are shown to be connected to existing sewers at a new manhole, the Contractor shall first expose the existing sewer and install a supporting timber beam with suitable straps around the pipe so as to bridge the excavation from the new manhole. The manhole shall then be constructed complete with invert and frame and cover. Under special conditions, and with the approval of the Engineer, the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations. No bypassing of sewage flows to ditches, streams, storm sewers, or the ground will be permitted. Actual physical connection of the sewers will be made at a later date, as directed by the Engineer.

In all cases the Contractor shall locate and uncover existing sewers and shall verify invert elevations before laying the connecting sewer so as to allow opportunity for making adjustments to compensate for discrepancies.

When connections are made with sewers carrying sewage or water, special care must be taken that no part of the work is built under water; a flume or dam must be installed and pumping maintained if necessary to keep the new work in the dry until completed and concrete or mortar has set up.

B. SERVICE CONNECTIONS

Sewer service lines shall be provided as shown on the plans, cut sheets, or as directed by the Engineer. Service connections shall consist of six (6") inch wyes and forty-five degree (45°) bends, risers, double wyes and bends, as required and six (6") inch house service lines. Pipe and fitting joints shall be compression type as used on the main sewer. Service pipe and fittings shall be of the same material as used for the main sewer.

As far as possible, the branch of the wye shall incline upwards at approximately forty-five (45°) degrees above a horizontal line normal to the flow of the sewer. A forty-five (45°) degree bend, short radius, shall be used to connect the service wye to the house service. The branch of the wye, including the bend, shall be placed on a solidly compacted bed of crushed stone and connected to the wye in such a manner as to be self-supporting and to relieve the strain on the branch and the bend. Where trench depths are such that risers are required, the branch of the wye and the bend shall be set in a vertical position and the entire length of the wye encased in concrete in conformance with the Standard Detail Drawing. Risers shall extend to the heights directed by the Engineer and shall be encased in a brick masonry stack as shown on the Standard Detail Drawing. Bends and/or double wyes and bends shall be used to connect the riser to the house sewer.

Service pipe shall be laid on a slope of one-fourth (1/4") inch per foot or, where this grade is not available and the Engineer specifically approves, one-eighth (1/8") inch per foot may be used. In no event shall the service line be less than three and one-half (3½') feet deep to invert of the pipe at the property line. Sewer service lines shall conform to details as shown on the Standard Detail Drawing and shall terminate in the center of the lot at the property line (unless otherwise approved by the Department prior to approval of the construction drawings) with a watertight PVC cap or fernco. Each cap is to be installed with the completion of each service. After the cap or fernco is placed in its proper position, it shall be backfilled with crushed stone to a point twelve (12") inches above the cap or fernco.

Markers shall be installed at the end of all house service lines. The material for the marker shall be a one (1) inch pvc pipe with green paint at the top, one foot in height. The marker/pipe shall be approximately 10 feet in length placed vertically in the trench and shall extend from the invert of the sewer to a point above the surface of the ground.

C. CONCRETE PIERS

Concrete piers for sanitary sewers shall be constructed of Class "A" concrete and shall conform to the details shown on the Plans. A saddle conforming to the outside of the pipe shall be constructed in the top of all piers. Pipe shall be blocked to proper grade and then grouted in place in the saddle with 1:2 cement mortar. Pipe straps shall be installed on all piers.

Piers supporting pipelines across streams shall be anchored into rock in accordance with details shown on the Plans, so as to resist overturning during periods of flood stages in the stream. Holes shall be drilled two and one-half (2½") inches minimum diameter into the rock after excavation for the footing is complete, and reinforcing bars embedded in grout made with high-early strength cement poured into the holes. With wet holes, grout shall be deposited by means of a trowel. Straight bars shall be used and bent over for anchorage after the concrete has attained its full strength.

3.6 CLEANUP

The Contractor shall not, without the permission of the Engineer, Owner, and property owner, remove from the line of work any earth excavated therefrom. Earth which may be suitable for backfilling or surfacing shall be used for that purpose.

As soon as the backfilling of any excavation is completed, and when in areas of existing development, the Contractor must at once begin the removal of all surplus dirt except that actually necessary to provide for the settlement of the fill. The Contractor shall also remove all the pipe and other material placed or left on the street except material needed for the replacement of paving, and the street shall be opened up and made passable for traffic. Following the above work, the repairing and complete restoration of the street surfaces, bridges, crossings, and all places affected by the work shall be done as promptly as possible.

All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, yards, etc., and the whole work shall be left in tidy and acceptable condition.

The Engineer shall be sole authority in determining time in which rough and final cleanup shall be prosecuted. Rough cleanup shall consist of removal of rocks larger than six (6) inches in any dimension, grading of excess backfill material over pipeline or removal of said material, opening of any drainage device, restoration of any street or roadway to condition so that traffic may safely and conveniently use street or road, restoration of pedestrian ways to condition where pedestrians may safely and conveniently use same. Rough cleanup shall, in general, be prosecuted no later than one (1) day after pipe laying and backfilling or no farther behind pipe laying operations than one thousand (1,000') feet; whichever time limit is shortest shall govern. Final cleanup consisting of pavement replacement, sidewalk replacement, removal of rocks, hand raking, seeding, strawing, etc., of lawns and neutral grounds, adjusting grade of ground over pipeline, property repairs, and other items necessary to restore the property to a condition similar or equal to that existing prior to construction shall, in general, be prosecuted no later than three (3) weeks after completion of backfilling.

3.7 SPECIAL WORK AREAS

A. GENERAL

The Contractor's attention is called to special conditions that exist in certain special areas that are commonly encountered in the installation of sewer lines, namely:

1. In easements
2. On state highway, railroad and gas right-of-ways
3. Stream Crossings

The special conditions for these areas are discussed herein in Sections B, C, and D. All, some, or none of these areas may be encountered in the project for which

these specifications apply. Prior to working in these special areas, the Developer will be required to post surety in the amount of cash, letter of credit or bond. The amount of surety will be 100% of the construction cost estimate for the water, sewer and/or repurified water improvements within these areas.

B. WORK IN EASEMENTS

The Contractor shall take care in working on private property where easements have been obtained in order to install the sewer line. The Contractor shall make inquiry as to whether the property owner wishes to retain the material from the excavation occurring on the property owner's property. If the property owner desires to keep excess material on the property, Contractor shall receive written permission from property owner to stockpile excess material in an area designated by property owner. At no time shall the Contractor remove any excavated material from the property without first inquiring as to property owner's desire of whether to retain material generated on their property. Any excess material, if not desired by the property owner, shall be disposed of in accordance with Section 3.6.

C. STATE HIGHWAY/ RAILROAD CROSSINGS/GAS CROSSINGS

The installation of sewer lines along and across state highways shall be made in accordance with the details shown on the Plans, as specified herein, and with all requirements of the Tennessee Department of Transportation (TDOT) with reference to construction operations, safety, traffic control, road maintenance and repair, etc.

The installation of sewer lines along and across railroads and/or gas mains shall be made in accordance with the details shown on the Plans, as specified herein, and with all requirements of the Railroad and/or Gas Company with reference to construction operations, safety, maintenance of service, etc.

Permits for such work will be obtained by the Owner/Developer. All costs for labor, materials, and supervisory personnel furnished by TDOT, the Railroad Company and/or Gas Company in connection with the work, if any, shall be at the expense of the Contractor. The Contractor shall fully inform himself/herself of the conditions and insurance requirements of the permit and fully comply with those conditions and requirements.

The Contractor shall be responsible for fully informing himself with regard to all TDOT, Railroad and/or Gas Company regulations and conditions relating to pipeline crossings.

The Contractor shall be responsible for notifying TDOT, the Railroad and/or Gas Company when work is to begin on the crossing.

D. STREAM CROSSINGS

Where indicated on the Plans, special construction shall be used at stream crossings. Details shall be as shown on the Plans. In these areas, the Contractor shall drill a line of perimeter holes spaced no more than 2 times the diameter of the drilled holes. The perimeter holes shall be a maximum of 3" in diameter and shall not be charged with explosives. Also, the perimeter holes shall be drilled vertically and to a minimum of three (3) feet below the proposed invert of the sewer line. Inside the creek crossing zone, the Contractor shall drill holes inside the perimeter holes in a pattern suitable to rubblize the trench rock. The Contractor shall not use more than five (5) pounds of explosives per delay for the drilled holes inside the perimeter holes in the designated creek crossing zone.

When required, the Owner/Developer will submit the appropriate permit applications and details to TDEC and the U.S. Army Corps of Engineers so that appropriate permits can be obtained for the stream crossings. The Contractor shall be required to adhere to the permit requirements from each agency for the sewer line crossing of the stream.

3.8 ACCEPTANCE OF WORK

Sewer lines and appurtenances will not be considered ready for acceptance until all provisions of these Specifications have been complied with, until all tests have been satisfactorily completed, and until final inspection of the work has been made. Sewage flows shall not be diverted into new sewers until after such time as final inspection of the lines has been made by the Engineer and permission granted thereof.

END OF SECTION 02722

SECTION 02724

SEWAGE FORCE MAIN

PART 1 – GENERAL

1.1 SCOPE OF WORK

The work covered by this Section relates to sanitary sewer force mains, four (4) inch and larger, including type materials permitted, installation, testing, and cleanup. See the STEP System Specifications for forcemains three (3) inches and smaller.

1.2 TYPE MATERIAL PERMITTED

Pipe material for all sanitary sewer force mains eight (8") inches and larger shall be ductile iron. C900 PVC pipe, GREEN in color, will be permitted for force mains six (6") inches in diameter or smaller unless special or unusual construction conditions are encountered.

1.3 DELIVERY, STORAGE, AND HANDLING

It shall be the Contractor's responsibility to ensure that all necessary materials are furnished, and that those found to be defective in manufacture are replaced at no extra cost to the Owner. Materials damaged in handling after being delivered by the manufacturer shall be replaced at the Contractor's own expense. If installed material is found to be defective before the final acceptance of the work, the cost of both the material and labor needed to replace it shall not be passed on to the Owner.

The Contractor shall be responsible for safely storing materials until they have been incorporated into the completed project. Keep the interiors of all pipes, fittings, and other accessories free from dirt and foreign matter at all times.

1.4 STANDARDS

Where materials and methods are indicated in the following specifications as being in conformance with a standard specification, it shall refer in all cases to the latest edition of the standard specification and shall include all interim revisions. Listing of a standard specification without further reference indicates that the particular material or method shall conform with such listed specification.

All materials to be incorporated in this project shall be first quality, new, and undamaged material conforming to all applicable portions of these specifications. Where deviation from the specifications is necessary because of changes in manufacturing procedures, inability to obtain the specified product, or other extenuating circumstances, a request for the proposed substitution shall be submitted to the Engineer in writing for consideration. Materials failing to conform to these specifications shall not be delivered to the job site.

unless the Contractor has written approval from the Engineer covering the substitute materials.

The supplier must provide and deliver pipe manufactured by one company per project/job only. The mixing of different pipe manufacturers will no longer be accepted. Jobs can be broken into separate sections and/or phases as approved by the Murfreesboro Water Resources Department.

1.5 RELATED WORK SPECIFIED ELSEWHERE

Refer to following Sections of these Specifications for work related to this Section:

- A. Section 02221W – Trenching, Bedding and Backfilling for Water Lines, Sewage Force Mains and Repurified Water Lines
- B. Section 02600 – Manholes
- C. Section 03303 – Concrete for Water Lines, Sanitary Sewer Mains and Repurified Water Lines and Appurtenances

PART 2 – PRODUCTS

2.1 GENERAL PIPE REQUIREMENTS

A. QUALITY AND INSPECTION

Latitudes in workmanship and finish allowed by ASTM Specifications notwithstanding, all pipe shall be first quality, of smooth exterior and interior surfaces, free from cracks, blisters, and other imperfections, and true to theoretical shapes and forms throughout each length. All pipe, independent of laboratory tests, shall be subject to the inspection of the Engineer at the pipe plant, trench, or other point of delivery for the purpose of culling and rejecting pipe which does not conform to the requirements of these Specifications. Pipe which does not conform shall be marked as such by the Engineer and shall not be delivered or used in the work. Repairing of rejected pipe will not be permitted.

B. EXPERIENCE OF MANUFACTURER

The manufacturer of the pipe shall submit evidence, if requested by the Engineer, of having consistently produced both pipe and joints of specified quality and satisfactory performance results in service over a period of at least two years. The manufacturing process shall be subject to the approval of the Engineer.

2.2 DUCTILE IRON PIPE

A. MATERIAL

Ductile iron pipe shall conform to ANSI/AWWA/C151/A21.51, latest revisions for ductile iron pipe centrifugally cast in metal or sand lined molds. Pipe shall have asphaltic coating on the exterior. Pipe shall have an interior lining of coal

tar epoxy, amine cured novalac epoxy containing ceramic quartz pigment, or polyethylene lining. Pipe shall be made with 60-42-10 grade ductile iron, or stronger, and pressure Class 350 shall be used unless noted otherwise on the Plans.

B. JOINTS

Joints shall be push-on type compression joints unless otherwise indicated and shall conform to ANSI/AWWA/C111/A21.11, latest revisions. Gaskets and lubricant shall be furnished with the pipe. Where shown on the Plans or required, joints shall be designed and factory fabricated for extra deflection to the maximum for various pipe sizes as shown in published tables supplied by the pipe manufacturer.

C. TESTING

Testing of ductile iron pipe and joints shall be performed in accordance with ANSI/AWWA/C151/A21.51, latest revisions and ANSI/AWWA/C151/A21.11, latest revisions.

D. MARKING

The weight, class, manufacturer's mark, year of manufacture, and letters "DI" or "DUCTILE" shall be cast or stamped on pipe.

E. CERTIFICATIONS

Manufacturer shall furnish certifications as follows:

1. That the pipe and joints have been manufactured in accordance with ANSI/AWWA/C151/A21.51, latest revisions and ANSI/AWWA/C111/A21.11, latest revisions.
2. The pipe and joints have been tested in accordance with the procedures as outlined in ANSI/AWWA/C151/A21.51, latest revisions, and ANSI/AWWA/C111/A21.11, latest revisions.

F. LENGTHS

Pipe shall be furnished in lengths of eighteen (18') feet or twenty (20') feet long, except for special construction conditions.

G. INTERIOR COATING FOR DUCTILE IRON PIPE

The pipe manufacturer shall submit complete information on the proposed coating system, method of application and application personnel to the Engineer and shall receive the Engineer's approval before undertaking any pipe coating. Certified copies of the manufacturer testing results shall also be submitted to the Engineer by the pipe manufacturer.

In addition to the certifications to be provided by the pipe manufacturer, the Owner may retain an independent Testing Laboratory to inspect and label the pipe before the coating application begins. If so directed, the independent Testing Laboratory provided by the Owner will make random selections of up to one (1%) percent of the coated pipe sections which will be visually inspected, checked for **holidays**, and tested for dry film thickness. Any patching or recoating of the test sections shall be done by the Applicator at no additional cost. Any changes in procedure or any recoating necessary to correct defective coating systems shall be carried out promptly upon notification of such deficiencies.

1. Interior coating for ductile iron pipe shall consist of a coal tar epoxy lining system applied in strict accordance with the coating manufacturer's recommendations and these Specifications. The coating shall be equivalent to Kopcoat 300-M or Tnemec 46H-413 Hi Build Tnemec – Tar.
2. Cured novalac epoxy lining for ductile iron pipe shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Lining shall be forty (40) mils nominal thickness.
3. Polyethylene lining for ductile iron pipe shall be of virgin polyethylene complying with ASTM D-1248 compounded with sufficient lamp black to resist ultraviolet rays during above ground storage of the pipe. Lining shall be heat fused to the interior of the pipe and shall be approximately forty (40) mils thick.

H. MANUFACTURER

Ductile iron pipe shall be as manufactured by U.S. Pipe/Griffin Pipe and Foundry Company, American Cast Iron Pipe Company, McWane Pipe/James B. Clow and Sons, or an approved equal.

2.3 POLYVINYL CHLORIDE (PVC) PIPE

A. MATERIAL

PVC pipe shall conform to the requirements of AWWA C900 "Standard for Polyvinyl Chloride (PVC) Pressure Pipe, four (4") inches through twelve (12") inches for Water Distribution" and furnished in cast iron pipe equivalent outside diameters of DR 18 with integral wall thickened bell ends and pressure Class 150, unless directed otherwise by the Engineer. In all cases the pipe must be "GREEN" in color.

B. JOINTS

Provision must be made for contraction and expansion of each joint with flexible ring gaskets from rubber or other suitable material. Gasket materials shall meet the requirements established in ASTM F477. Joints for pipe shall be

manufactured in accordance with ASTM D 3139. Lubricant shall be nontoxic and shall not promote biological growth. Solvent cemented joints in the field are not permitted.

C. TESTING

The following tests shall be run for each machine on each size and type of pipe being produced as specified.

1. FLATTENING TEST

Once per shift in accordance with ASTM D2412. Upon completion of the test, the specimen shall not be split, cracked, or broken.

2. ACETONE TEST (Extrusion Quality Test)

Once per shift in accordance with ASTM D2152. There shall be no flaking, peeling, cracking, or visible deterioration on the inside or outside surface after completion of the tests.

3. QUICK BURST TEST

Once per twenty-four (24) hours in accordance with ASTM 1599.

4. WALL THICKNESS AND OUTSIDE DIMENSIONS TEST

Once per hour in accordance with ASTM D2122.

5. BELL DIMENSIONS TEST

Once per hour in accordance with ASTM D3139.

If any specimen fails to meet any of the above-mentioned tests, all pipe of that size and type measured between the test periods must be scrapped and a full set of tests rerun.

D. MARKING

Certain information shall be applied to each piece of pipe. At the least, this shall consist of:

1. Nominal size
2. Type of material
3. SDR or class
4. Manufacturer
5. NSF Seal of Approval

E. CERTIFICATIONS

The manufacturer shall furnish certifications as follows:

1. That the pipe and joints have been manufactured in accordance with AWWA C900 "Standard for Polyvinyl Chloride (PVC) Pressure Pipe, four (4") inches through twelve (12") inches, for Water Distribution".
2. That the pipe and joints have been tested in accordance with the ASTM designations for the respective tests designated in C.

F. LENGTHS

Pipe shall be furnished in lengths of twenty (20) feet, except for special construction conditions.

G. DETECTION WIRE

Pipe shall have a twenty-four (24) TW solid copper wire with a white coating installed in such manner that detection with electronic equipment is possible. The detection wire shall be continuous and shall be installed at the side of the trench adjacent to the pipe.

H. MANUFACTURER

Pipe shall be as manufactured by JM-Eagle Manufacturing, National, North American Pipe, Pipelife Jet Stream Inc., Diamond Plastics, Royal Building Products, Sanderson Pipe or an approved equal.

2.4 PIPE FITTINGS

Fittings furnished for use with PVC or ductile iron pipe shall be fittings conforming to ANSI/AWWA/C110/A21.10, latest revisions. Unless otherwise indicated, ends shall be mechanical joint. Fittings shall have interior lining and exterior coating as specified for pipe. Fittings shall be of ductile iron. Ductile iron compact fittings shall conform to ANSI/AWWA/C153/A21.53. Fittings shall have a pressure rating of 350 psi.

Fittings shall be in accordance with standard mechanical joint fittings as manufactured by the U.S./Griffin Pipe and Foundry Company, American Cast Iron Pipe Company, McWane/James B. Clow and Sons, Tyler/Union, Sigma, Star, SIP Industries or an approved equal.

2.5 CASING PIPE

The minimum material requirements for casing pipe used in highway and railroad crossings shall be steel conforming to ASTM A 139, Grade B. Minimum yield strength shall be 35,000 psi. All casing pipe used must meet the approval of the permitting

authority. If the casing pipe is being used in a bore situation within the City's rights-of-way, the bore must extend to 10 feet beyond the toe of the slope and/or the back of the ditch and at minimum from right-of-way to right-of-way. Nominal casing diameter shall be as indicated on the plans as determined by the Department, but shall be 2 times larger than the diameter of the carrier pipe minimum. Joints shall be continuously welded. Casing pipe and joints shall be leakproof and capable of withstanding Cooper E-80 loading. Casing pipe shall be coated as specified herein.

The minimum wall thickness of casing pipe shall be as shown in the table below.

<u>Nominal Diameter (Inches)</u>	<u>Minimum Wall Thickness (Inches)</u>	
	<u>With Coating</u>	<u>Without Coating</u>
Under 14	0.188	0.251
14 and 16	0.219	0.282
18	0.250	0.313
20	0.281	0.344
22	0.312	0.375
24	0.344	0.407
26	0.375	0.438
28 and 30	0.406	0.469
32	0.438	0.501
34 and 36	0.469	0.532
38, 40, 42	0.500	0.563

Where specified, coating for steel casing pipe shall be a two component, self-priming, chemically cured coal tar epoxy-polyamide protective coating. Minimum dry film thickness of completed coating shall be sixteen (16) mils. Material shall be Kopcoat 300 M, Tnemec 46H-413 Hi Build Tneme – Tar or equal. Preparation shall be SP6 commercial blast.

2.6 VALVES AND VALVE BOXES

A. CHECK VALVES

Check valves shall be Dresser (M&H) or equal and shall match existing check valves in size and laying length.

B. GATE VALVES

Gate valves three (3") inches through twelve (12") inches shall be resilient seated, solid wedge, manufactured to meet or exceed the requirements of AWWA C-509 or C515 of latest revision. Each valve shall have the manufacturer's name, pressure rating, and year in which it was manufactured cast in the body. The body, bonnet and the o-ring plate shall be fusion bonded epoxy coated inside and out in accordance with AWWA C550 and shall be NSF 61 Certified. Gate valves fourteen (14") inches in diameter and larger shall be resilient seated, solid wedge type and shall be similar to AWWA C-500 latest revision, but may be furnished

for 150 psi working pressure. Double disc valves having not more than four internal parts, excluding the valve stem, and with discs and wedging mechanism free from pockets, pins, lugs, or ribs which would trap solids and interfere with operations may be furnished, with cleanouts in lieu of solid wedge gates. Cleanouts shall be of such design that valve may be cleaned or flushed while the valve is in service in the closed position. All gate valves shall be of such design that valves may be installed in either a horizontal or vertical position.

Buried valves shall be mechanical joint, equipped with a two (2") inch square operating nut and shall be housed in valve boxes as specified herein. The valves are to be non-rising stem. Two stem seals shall be provided and shall be of the O-ring type. Valves shall open to the left.

Valve supplier shall furnish two standard stem iron wrenches for turning nut-operated valves.

Iron body gate valves shall be American Flow Control, Mueller, M&H, U.S. Pipe Company, or equal.

C. VALVE BOXES

Valve boxes shall consist of precast concrete sections with cast iron frames and covers. The precast concrete sections are each approximately six (6") inches high with a minimum inside opening of eleven by thirteen (11" x 13") inches. Manufacturer shall be Hula Concrete Products of Hickman, TN, or Thomas Holton of Christiana, TN or approved equal.

The cast iron frame and lid shall be roadway type, Bouchard No. 8006, **EJ 00804123A01**, or equal having inside dimensions of eleven by thirteen and one-fourth (11" x 13¼") inches and a height of six and one-half (6½") inches. The combined weight of frame and cover shall be one hundred ninety-five (195) pounds.

D. COMBINATION AIR RELEASE VALVES

Sewage combination automatic air release/air and vacuum valves shall be APCO, Crispin or equal, sized and installed in a manhole as shown on the Standard Detail Drawing. The air release valves are required to have a backflush fitting with a hose. The saddle connections to the forcemain shall be Ford or Smith-Blair with brass nipples and bronze wheel valves. The part numbers are:

4" x 1" Tapping Saddle	single band	FC101-480-CC4
6" x 1" Tapping Saddle	single band	FC101-760-CC4
8" x 1" Tapping Saddle	single band	FC101-979-CC4
8" x 2" Tapping Saddle	single band	FC101-979-CC7

2.7CONCRETE

A. CLASS "A" CONCRETE

Class “A” concrete shall have a minimum compressive strength of four-thousand (4,000) pounds per square inch in twenty-eight (28) days and shall contain not less than six-hundred (600) pounds of cement per cubic yard.

B. CLASS “B” CONCRETE

Class “B” concrete shall have a minimum compressive strength of three-thousand (3,000) pounds per square inch in twenty-eight (28) days and shall contain not less than five-hundred-fifty (550) pounds of cement per cubic yard.

PART 3 – EXECUTION

3.1 GENERAL

Prior to construction, the Contractor is responsible for obtaining coverage under the State’s Construction General Permit and City Land Disturbance, in cases where the disturbed area covers more than an acre; and for implementing erosion and sediment controls as required.

The Contractor will be held completely responsible for any damage to pavement, sidewalks, curbs, gutters, meter or valve boxes, street inlets, or other structures or appurtenances as a result of construction operations. It should be specifically noted that the Contractor shall be responsible for damage even though the character or nature of the original pavement or structure was such that it was not capable of carrying the load of the construction equipment regardless of the construction methods used.

The Contractor shall take precautions as may be necessary to avoid endangering personnel, pavement, adjacent utilities, or structures through cave-ins, slides, settlement, or other soil disturbance resulting from construction operations. The Contractor shall furnish and maintain barricades, signs, flashing lights, and other warning devices as necessary for public safety and as required by the Manual on Uniform Traffic Control Devices, Part 6.

The Contractor shall plan construction operations to minimize inconvenience to property owners and to traffic. Traffic Control Plans may be required prior to construction, which may include flaggers, barriers, signs, etc. No road, street, or alley may be closed unless absolutely necessary, and then only if the following conditions are met:

- A. Permit is secured from appropriate State, County, or City authorities having jurisdiction.
- B. Fire and Police Departments and other emergency services are notified before road is closed.
- C. Suitable detours are provided and are clearly marked.

No driveways shall be cut or blocked without giving twenty-four (24) hour notice to the occupant of the property. Every effort shall be made to schedule the blocking of drives to suit the occupant's convenience, and except in case of emergency, drives shall not be blocked without an alternative access being provided.

Whenever pipe laying operations are to be discontinued for an extended period of time, the end of the pipe shall be carefully secured to avoid displacement or misalignment, and a tight-fitting plug or stopper shall be placed in the line. Upon resumption of laying operations, the plug or stopper shall not be removed from the line until any water, mud, or other debris has been removed to avoid entry into the completed section of the force main.

Installation of force main shall conform to provisions of these specifications and recommendations of the pipe manufacturer. Installation instructions provided by the pipe manufacturer shall be available at all times at the location of the work.

The proper gaskets and lubricants shall be furnished by the pipe manufacturer, and lubricants shall be delivered to the job site in properly labeled, unopened containers.

When force mains are to be constructed near water mains, horizontal and vertical separation shall be maintained as described as follows:

Horizontal Separation: Whenever possible, force mains should be separated horizontally from water mains a minimum of ten (10') feet. If this is not possible, the lines may be laid closer provided they are in separate trenches, and if the elevation of the top of the force main is at least eighteen (18") inches below the bottom of the water main.

Vertical Separation: When a force main must cross a water main, the top of the force main should be at least eighteen (18") inches below the bottom of the water main.

If the elevation of the force main cannot be varied to meet the above requirements, relocate the water main to provide this separation, or else reconstruct it with mechanical joint ductile iron pipe for a distance of ten (10') feet on each side of the force main with a full joint of the water main centered on the sewer. If it is impossible to obtain proper horizontal and vertical separation as stipulated herein, construct both the water main and the force main of mechanical joint ductile iron pipe and pressure test each.

The Contractor shall submit a proposed construction schedule for the Engineer's approval before construction begins. If the sewer is to be installed in a proposed road, the road shall be graded to subgrade before the force main is installed. The normal requirement will be to begin pipelaying at the lower end of any proposed line and continue laying upstream until the line is completed. Construction will begin at points where proposed force mains tie into existing or proposed pump stations.

3.2 EXCAVATION AND BEDDING

The trench excavation for force mains and the excavation for manholes and other structures, including excavation in solid rock, and any necessary foundation stabilization, dewatering, sheeting or shoring, and the disposal of materials shall be done in accordance with Section 02221W, Trenching, Bedding and Backfilling for Water Lines, Sewage Force Mains and Repurified Water Lines.

In wet or mucky areas where the subgrade or the trench walls have insufficient stability to support the installed force main, the Contractor will be directed to remove such unstable material and replace same with crushed stone size No. 67 as given in Section 903 of the latest Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction. Where the wet or mucky condition is caused by the Contractor's failure or neglect to properly handle ground water or protect against the entrance of storm water, the Contractor will be required to remove and replace the unstable material at no expense to the Owner.

Unless otherwise indicated by the Plans, all force mains shall have at least forty-two (42") inches of cover. The pipe shall slope continuously between high and low points and have a minimum of sixty (60") inches cover at the high points. No departure from this policy shall be made except by order of the Engineer.

3.3 PIPE INSTALLATION

The Contractor shall exercise care in the storage and handling of pipe, both on the storage yard and at the site of laying operations. Suitable clamps, slings, or other lifting devices shall be provided for handling pipe and fittings. Pipe and fittings shall be carefully lowered into the trench piece by piece. **Pipe and fittings shall be inspected for defects and for dirt or other foreign material immediately before placing them in the trench.** Suitable swabs shall be available at the site of laying operations, and any dirt or foreign material shall be removed from the pipe before it is lowered into the trench. Take every precaution to keep foreign material from getting into the pipe while it is being placed in the line. If the crew laying the pipe cannot put it into the trench and in place without allowing earth to get inside it, then place a heavy, tightly woven canvas bag of suitable size over each end of the pipe and leave it there until it is time to connect that pipe to the one adjacent to it.

After a length of pipe has been placed in the trench, center the spigot end of the bell of the adjacent pipe, and then insert to the depth specified by the manufacturer, and bring to the correct line and grade. Secure the pipe in place by tamping an approved backfill material around it.

Bell holes shall be big enough so that there is ample room for the pipe joints to be properly made. Between bell holes, carefully grade the bottom of the trench so that each pipe barrel will rest on a solid foundation for its entire length.

Whenever pipe laying operations are to be discontinued for an extended period of time, the end of the pipe shall be carefully secured to avoid displacement or misalignment, and a tight-fitting plug or stopper shall be placed in the line. Upon resumption of laying

operations, the plug or stopper shall not be removed from the line until any water, mud, or other debris has been removed to avoid entry into the completed section of pipe.

Installation of force mains shall conform to provisions of these specifications and recommendations of the pipe manufacturer. Installation instructions provided by the pipe manufacturer shall be available at all times at the location of the work.

The trench for the force main, including the bottom, bedding, sides, backfilling, and any necessary foundation stabilization, dewatering, sheeting or shoring, and the disposal of materials shall be prepared or done in accordance with Section 02221W, Trenching, Bedding and Backfilling for Waterlines and Sewage Force Mains.

The Contractor will be required to exercise care to maintain satisfactory grades and alignments and avoid unnecessary kinks, sags, or high points. Exact grades or centerline elevations where not indicated on the drawings are not required, but grades shall be such as to provide a continuous upward slope to discharge point or other summit point where facilities for release of air shall be provided.

Unless otherwise indicated, pipe shall be laid with slip type compression joints, equal to the manufacturer's standard for pressure water pipe, and assembly of the joints shall be in accordance with the manufacturer's recommendations using lubricant and accessories as provided by the pipe manufacturer.

Changes in grade or alignment may be made by means of deflection in pipe joints provided that the recommended deflection, as shown in published tables supplied by the pipe manufacturer, are not exceeded. The Contractor shall have on hand at the site of the work a table showing the permissible deflections whenever the pipe laying is in progress.

Whenever it is necessary to cut a joint of pipe in order to fit the trench conditions, the cutting shall be done using the equipment as recommended by the manufacturer for the specific type of pipe involved. The cut shall be made so as to leave a smooth end at right angles to the axis of the bore, and the end shall be bevelled or finished as required to make the joint without risk of damage to gasket.

3.4 THRUST BLOCKS OR RESTRAINT

Poured in place concrete thrust blocks must be provided at all points of unbalanced pressure where the pipeline could pull apart. Thrust blocks shall conform to details and minimum bearing areas as shown on the Standard Detail Drawings and shall bear against the undisturbed trench face. Care shall be taken to avoid pouring concrete over or around pipe joints and to protect bolts, glands, or other component parts of the joint while the thrust block is being poured.

Where over bends (downward bends) cannot be avoided, the fittings must be held in place by one of the following methods:

- A. Steel rods and clamps extending for two (2) full pipe lengths on each side of bend as designed by the Engineer and approved by the Department.

- B. Steel rods anchored for at least eighteen (18") inches in solid rock.
- C. Poured concrete under pipe of sufficient volume to counteract unbalanced force, with steel clamp and anchor bolts to hold fitting to concrete.

Rods and bolts shall have a minimum diameter of three-quarter ($\frac{3}{4}$ ") inch, and clamps or straps shall be of steel having at least one-fourth ($\frac{1}{4}$ ") inch thickness. Steel rods, bolts, clamps, etc. shall be coated with coal tar epoxy. Concrete used in thrust blocks shall be Class "B".

3.5 BACKFILLING

Backfilling shall be carried out as expeditiously as possible but shall not be undertaken until the Engineer and/or Inspector has been given the opportunity to inspect the work. The Contractor must carry out all backfilling operations with due regard for the protection of pipe, structures, and appurtenances, and procedures to obtain the desired degree of compaction.

The Contractor shall be responsible for and shall protect all sewers, storm sewers, and electric, telephone, water, or other pipes or conduits against danger or damage while excavated areas are being backfilled and from future settlement of the backfill. In all instances sufficient care must be exercised to avoid leaving any holes or voids over, around, or under stones, boulders, or other backfill material which may later be filled by leaching or settlement of surrounding material, thereby causing future trench settlement. Where damage should occur as a result of the Contractor's backfilling operations or from trench settlement, he shall repair such damage promptly at no cost to the Owner.

The three classes of acceptable backfill material and placement procedures are as described in Section 02221W Trenching, Bedding and Backfilling for Water Lines, Sewage Force Mains and Repurified Water Lines and as shown on the Standard Detail Drawings.

3.6 CLEANING, TESTING, AND ACCEPTANCE

A. GENERAL

Upon completion of construction, the Contractor shall remove all sand, dirt, brick, and other foreign materials from the force main and shall conduct an inspection to locate any defects and determine when the force main is ready for testing and acceptance by the Engineer. After all apparent defects have been corrected, the Contractor shall notify the Engineer and/or Inspector and request a final inspection. All underground conduit and utilities (Storm drainage, Water Mains, Murfreesboro Electric, Middle Tennessee Electric, Atmos Energy, Cable, etc) shall be installed prior to testing.

No final inspection will be scheduled by the Engineer until the Contractor advises that he has conducted an inspection and believes the project to be ready for such

final inspection. Should the Engineer begin a final inspection at the request of the Contractor and find that the force main has not been cleaned or defects have not been corrected, the inspection will be terminated and will not be rescheduled until the Contractor again advises that the project is ready for inspection.

Acceptance of the project shall involve both a visual inspection and a leakage test. The procedures shall be as outlined hereinafter. The work will not be accepted until both the visual inspection and leakage test results are satisfactory.

B. VISUAL INSPECTION

The Engineer will, as a part of the final inspection, make the necessary visual inspections to verify the quality of workmanship. Such inspections shall include observation of cleanup, pavement replacement, etc.

Any defects such as visible leaks, obstructions, cracked or broken pipe, or failure to restore the surface to a satisfactory condition must be corrected to the Engineer's satisfaction before acceptance.

C. TESTING FORCE MAINS

Before final acceptance, the force main shall be pressure tested by suitably closing the end of the main with a test plug of approved design suitably braced against the internal pressure to prevent blowout and possible injury to personnel.

Contractor shall furnish all labor, materials, and equipment for testing the force main, including but not limited to water for testing, test pump, pressure gauges, test plugs, etc. Test shall be performed by Contractor and witnessed by the Engineer.

The force main shall be filled with water taking care to eliminate air from the high points. A positive displacement test pump shall be used to pump clean water into the main to build up a test pressure equal to the normal system pressure plus 50 psi. Maximum required test pressure will be 150 psi. The test pump shall be valved off from the system and the pressure shall be observed over a period of one hour. A drop-in pressure of 5 psi or more during the one-hour test period shall be taken as an indication of leakage. In the event leaks are found and corrected, the Contractor shall repeat the pressure test using the same procedure described above. Should the Contractor be unable to obtain a satisfactory pressure test over a duration of one hour, he shall then be required to perform a leakage test using a water tap and standard water meter to measure the leakage in the test section at system pressure over a period of twenty-four (24) hours. Leakage during the twenty-four (24) hour period must not exceed the allowable leakage for mechanical or push-on joints as shown in AWWA C600-87. Leakage shall not exceed the quantity determined by the formula: $L = (SD \sqrt{P}) \div 133,200$ where L is allowable leakage in gallons per hour; S is length of pipeline tested in feet; D is nominal internal pipe diameter in inches; and P is the average test

pressure during the leakage test, in pounds per square inch. Should the system fail to pass the leakage test, the Contractor will be required to locate and correct the leaks and to retest the system until satisfactory results can be obtained.

The Contractor shall provide suitable first quality pressure gauges with five (5) lb. or smaller graduations and a standard 3/4 x 5/8 water meter in the event the meter is required for the leakage test. Pressure gauges and water meter shall be in good condition and shall be subject to such tests for proof of accuracy as the Engineer may require.

D. ACCEPTANCE

Force mains and appurtenances will not be considered ready for acceptance until all provisions of these Specifications have been complied with, until all tests have been satisfactorily completed, and until final inspection of the work has been made. Sewage flows shall not be diverted into new force mains until after such time as final inspection of the lines has been made by the Engineer and/or Inspector, and permission granted thereof.

3.7 CONNECTIONS & APPURTENANCES

A. CONNECTION TO EXISTING SYSTEM

No new force main shall be connected to the existing system until all new construction has been completed, is free of foreign materials, and obvious defects have been corrected. New force mains, then, must remain disconnected from the existing system by actual physical separation, by plugs of a type approved by the Engineer, or by other means approved by the Engineer.

The Contractor shall make connections to the existing or proposed pump station or the gravity sewer manhole in accordance with details as shown on the Plans or Standard Detail Drawings.

B. CONCRETE PIERS

Concrete piers for ductile iron force mains shall be constructed of Class "A" concrete and shall conform to the details shown on the Plans. A saddle conforming to the outside of the pipe shall be constructed in the top of all piers. Pipe shall be blocked to proper grade and then grouted in place in the saddle with 1:2 cement mortar. Pipe straps shall be installed on all piers.

Piers supporting pipelines across streams shall be anchored into rock in accordance with details shown on the Plans, so as to resist overturning during periods of flood stages in the stream. Holes shall be drilled two and one-half (2½") inches minimum diameter into the rock after excavation for the footing is complete, and reinforcing bars embedded in grout made with high-early strength cement poured into the holes. With wet holes, grout shall be deposited by means

of a trowel. Straight bars shall be used and bent over for anchorage after the concrete has attained its full strength.

3.8 SPECIAL WORK AREAS

A. GENERAL

The Contractor's attention is called to special conditions that exist in certain special areas that are commonly encountered in the installation of sewer lines, namely:

1. In easements
2. On state highway, railroad and gas right-of-ways
3. Stream Crossings

The special conditions for these areas are discussed herein in Sections B, C, and D. All, some, or none of these areas may be encountered in the project for which these specifications apply.

Surety in the amount of the sewer forcemain improvements must be deposited with the Department, prior to construction, when located within all special work areas.

B. WORK IN EASEMENTS

The Contractor shall take care in working on private property where easements have been obtained in order to install the sewer line. The Contractor shall make inquiry as to whether the property owner wishes to retain the material from the excavation occurring on the property owner's property. If the property owner desires to keep excess material on the property, Contractor shall receive written permission from property owner to stockpile excess material in an area designated by property owner. At no time shall the Contractor remove any excavated material from the property without first inquiring as to property owner's desire of whether to retain material generated on their property. Any excess material, if not desired by the property owner, shall be disposed of in accordance with Section 3.6.

C. STATE HIGHWAY/RAILROAD CROSSINGS/GAS CROSSINGS

The installation of force mains along and across state highways shall be made in accordance with the details shown on the Plans, as specified herein, and with all requirements of the Tennessee Department of Transportation (TDOT) with reference to construction operations, safety, traffic control, road maintenance and repair, etc.

The installation of force mains along and across railroads and/or gas mains shall be made in accordance with the details shown on the Plans, as specified herein,

and with all requirements of the Railroad and/or Gas Company with reference to construction operations, safety, maintenance of service, etc.

Permits for such work will be obtained by the Owner/Developer. All costs for labor, materials, and supervisory personnel furnished by the TDOT, the Railroad Company and/or Gas Company in connection with the work, if any, shall be at the expense of the Owner/Developer and/or Contractor. The Contractor shall fully inform himself/herself of the conditions and insurance requirements of the permit and fully comply with those conditions and requirements.

The Contractor shall be responsible for fully informing himself with regard to all TDOT, Railroad Company and/or Gas Company regulations and conditions relating to pipeline crossings.

The Contractor shall be responsible for notifying TDOT, the Railroad Company and/or Gas Company when work is about to begin on the crossing.

D. STREAM CROSSINGS

Where indicated on the Plans, special construction shall be used at stream crossings. Details shall be as shown on the Plans. These stream crossings require special construction materials or procedures. In these areas, the Contractor shall drill a line of perimeter holes spaced no more than 2 times the diameter of the drilled holes. The perimeter holes shall be a maximum of 3" in diameter and shall not be charged with explosives. Also, the perimeter holes shall be drilled vertically and to a minimum of three (3) feet below the proposed invert of the forcemain. Inside the creek crossing zone, the Contractor shall drill holes inside the perimeter holes in a pattern suitable to rubbleize the trench rock. The Contractor shall not use more than five (5) pounds of explosives per delay for the drilled holes inside the perimeter holes in the designated creek crossing zone.

When required, the Owner/Developer will submit the appropriate permit applications and details to TDEC and the U.S. Army Corps of Engineers so that appropriate permits can be obtained for the stream crossings. The Contractor shall be required to adhere to the permit requirements from each agency for the force main crossing of the stream.

3.9 CLEANUP

The Contractor shall not, without the permission of the Engineer, Owner, and property owner, remove from the line of work any earth excavated therefrom which may be suitable for backfilling or surfacing until the excavation has been refilled and surfaced.

As soon as the backfilling of any excavation is completed, and when in areas of existing development, the Contractor must at once begin the removal of all surplus dirt except that actually necessary to provide for the settlement of the fill. He shall also remove all the pipe and other material placed or left on the street by him except material needed for the replacement of paving, and the street shall be opened up and made passable for traffic. Following the above work, the repairing and complete restoration of the street surfaces,

bridges, crossings, and all places affected by the work shall be done as promptly as possible.

All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, yards, etc., and the whole work shall be left in tidy and acceptable condition.

The Engineer shall be sole authority in determining time in which rough and final cleanup shall be prosecuted. Rough cleanup shall consist of removal of rocks larger than six (6") inches in any dimension, grading of excess backfill material over pipeline or removal of said material, opening of any drainage device, restoration of any street or roadway to condition so that traffic may safely and conveniently use street or roadway, restoration of pedestrian ways to condition where pedestrians may safely and conveniently use same. Rough cleanup shall, in general be prosecuted no later than one (1) day after pipe laying and backfilling or no farther behind pipe laying operations than one thousand (1,000') feet; whichever time limit is shortest shall govern. Final cleanup consisting of pavement replacement, sidewalk replacement, removal of rocks, hand raking with seeding, strawing, etc. of lawns and neutral grounds, adjusting grade of ground over pipeline, property repairs, and other items shall, in general, be prosecuted no later than three (3) weeks after completion of backfilling.

END OF SECTION 02724

SECTION 03303

CONCRETE FOR WATER LINES, SANITARY SEWER MAINS, REPURIFIED WATER LINES, SEWER FORCEMAINS AND APPURTENANCES

PART 1 – GENERAL

1.1 SCOPE OF WORK

The work covered by this Section relates to concrete blocking, cradles, anchors, caps, protection, and/or encasement for water and sanitary sewer line appurtenances at the locations shown on the Plans or as directed by the Engineer, and in accordance with the Standard Detail Drawings.

1.2 STANDARD

The standard for this work shall be ACI 301-72 Specifications for Structural Concrete for Buildings (as revised) and as modified by the following supplemental requirements:

A. SECTION 3.2 STRENGTH

The minimum compressive strength for Class “B” concrete shall be three thousand (3,000) pounds per square inch in twenty-eight (28) days.

B. SECTION 3.4.1 DURABILITY

All concrete exposed to weather shall be air entrained. All concrete that will be underground need not be air entrained.

C. SECTION 3.5 SLUMP

Concrete shall be proportional and produced to have a slump of three (3”) inches with a one (1”) inch tolerance.

D. SECTION 3.7 ADMIXTURES

Air entrainment, mandatory for concrete exposed to weather, may be used. A water reducing admixture (retarding, normal, or accelerating, depending on placing temperature) may be used if approved by the Engineer.

E. SECTION 5.2.1 REINFORCING STEEL

Yield strength of reinforcing steel shall be sixty thousand (60,000) psi.

1.3 RELATED WORK SPECIFIED ELSEWHERE

Refer to other Sections of these Specifications for work related to this Section.

PART 2 – PRODUCTS

2.1 CONCRETE

Class “B” concrete for the water and sanitary sewer line appurtenances listed herein shall conform to the following:

A. CEMENT

Cement shall be Portland cement of a brand approved by the Engineers, and shall conform to “Standard Specifications for Portland Cement”, Type 1, ASTM Designation C150, latest revision.

B. FINE AGGREGATE

Fine aggregate shall be clean, hard, uncoated sand conforming to ASTM Designation C33, latest revision, “Standard Specifications for Concrete Aggregate”.

C. COARSE AGGREGATE

Coarse aggregate shall consist of clean, hard, dense particles of stone or gravel conforming to ASTM Designation C33, latest revision, “Standard Specifications for Concrete Aggregate”. Aggregate shall be well graded between one and one-half (1½”) inches and number four (4) sieve sizes.

D. WATER

Water used in mixing concrete shall be clean and free from organic matter, pollutants, and other foreign materials.

E. READY-MIX CONCRETE

Ready-mix concrete shall be secured only from a source approved by the Engineers, and shall conform to ASTM Designation C94, latest revision, “Specifications for Ready-Mix Concrete”. Before any concrete is delivered to the job site, the supplier must furnish a statement of the proportions of cement, fine aggregate, and coarse aggregate to be used for each mix ordered, and must receive the Engineer’s approval of such proportions.

2.2 STEEL REINFORCING

Reinforcing bars shall be intermediate grade steel conforming to ASTM Designation A15, latest revision, “Standard Specifications for Billet Steel Bars for Concrete Reinforcement”. Bars shall be deformed with a cross sectional area at all points equal to that of plain bars of equal nominal size.

PART 3 – EXECUTION

3.1 GENERAL

Place concrete appurtenances at locations shown on the Plans and in accordance with Standard Detail Drawings.

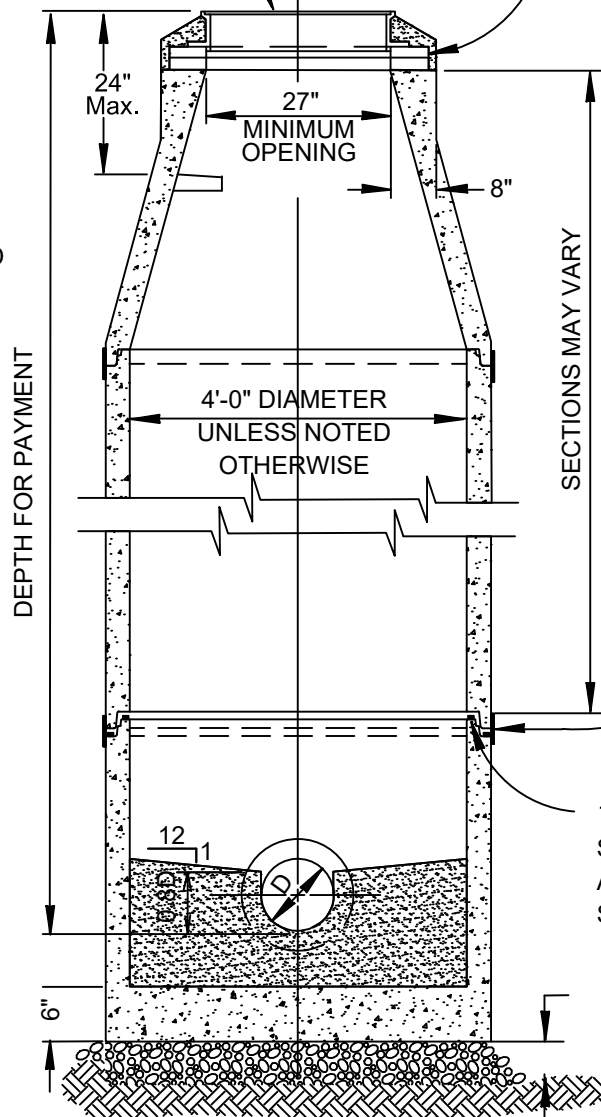
END OF SECTION 03303

MANHOLE FRAME & COVER-
SEE DRAWING S-2

PRECAST ADJUSTING RINGS
AS REQUIRED TO BRING TO GRADE.
SEE DRAWING S-3.

ALL PRECAST
MANHOLE SECTIONS
TO BE ASTM C478.
CONE SECTION TO BE
CONCENTRIC UNLESS
OTHERWISE APPROVED
BY ENGINEER

ALL INTERIOR TONGUE AND
GROOVE JOINTS TO BE WIPED
& ALL UNUSED STEP HOLES
TO BE FILLED WITH EMBECO
CEMENT MORTAR.



SEE DRAWING S-4
FOR INVERT AND
PIPE AT WALL
DETAILS

12" WIDE STRIP OF
POLYOLEFIN BACKED
EXTERIOR JOINT WRAP
AND PRIMER AT ALL JOINTS
SEE SPECIFICATIONS.

1-1/4 INCH FLEXIBLE BUTYL RESIN
STRIPS OF JOINT SEALANT
AT ALL JOINTS. SEE
SPECIFICATIONS.

6" CRUSHED
STONE BASE

DRAWING NOT TO SCALE

MAY 27, 1994

DRAWN BY: KMC
APPROVED BY: VHS
DATE REVISED: 3/24/05, 12/30/08, &
8/11/11

PRECAST CONCRETE
MANHOLE

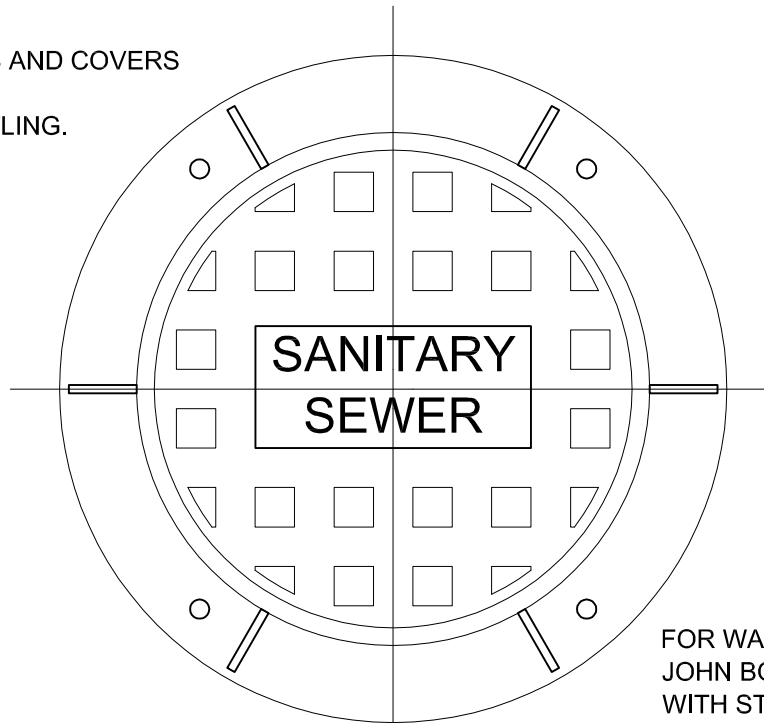
STANDARD
DRAWING NO.

S - 1

MURFREESBORO WATER & SEWER DEPARTMENT

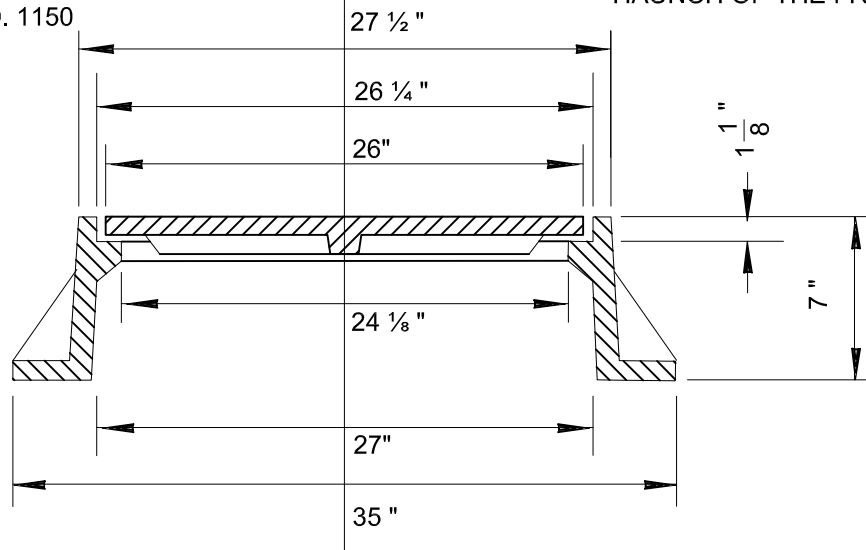
MANHOLE FRAMES AND COVERS
TO BE MACHINED
TO PREVENT RATTLING.

FRAME 235 LBS.
COVER 180 LBS.
TOTAL 415 LBS.



FRAME & COVER TO BE JOHN
BOUCHARD & SONS NO. 1150
OR EQUAL.

FOR WATERTIGHT MANHOLE USE
JOHN BOUCHARD & SONS NO. 1150
WITH STAINLESS STEEL SCREWS
AND GASKET OR EQUAL. HOLE
FOR SCREWS TO BE DRILLED
COMPLETELY THROUGH THE
HAUNCH OF THE FRAME.



DRAWING NOT TO SCALE

MAY 27, 1994

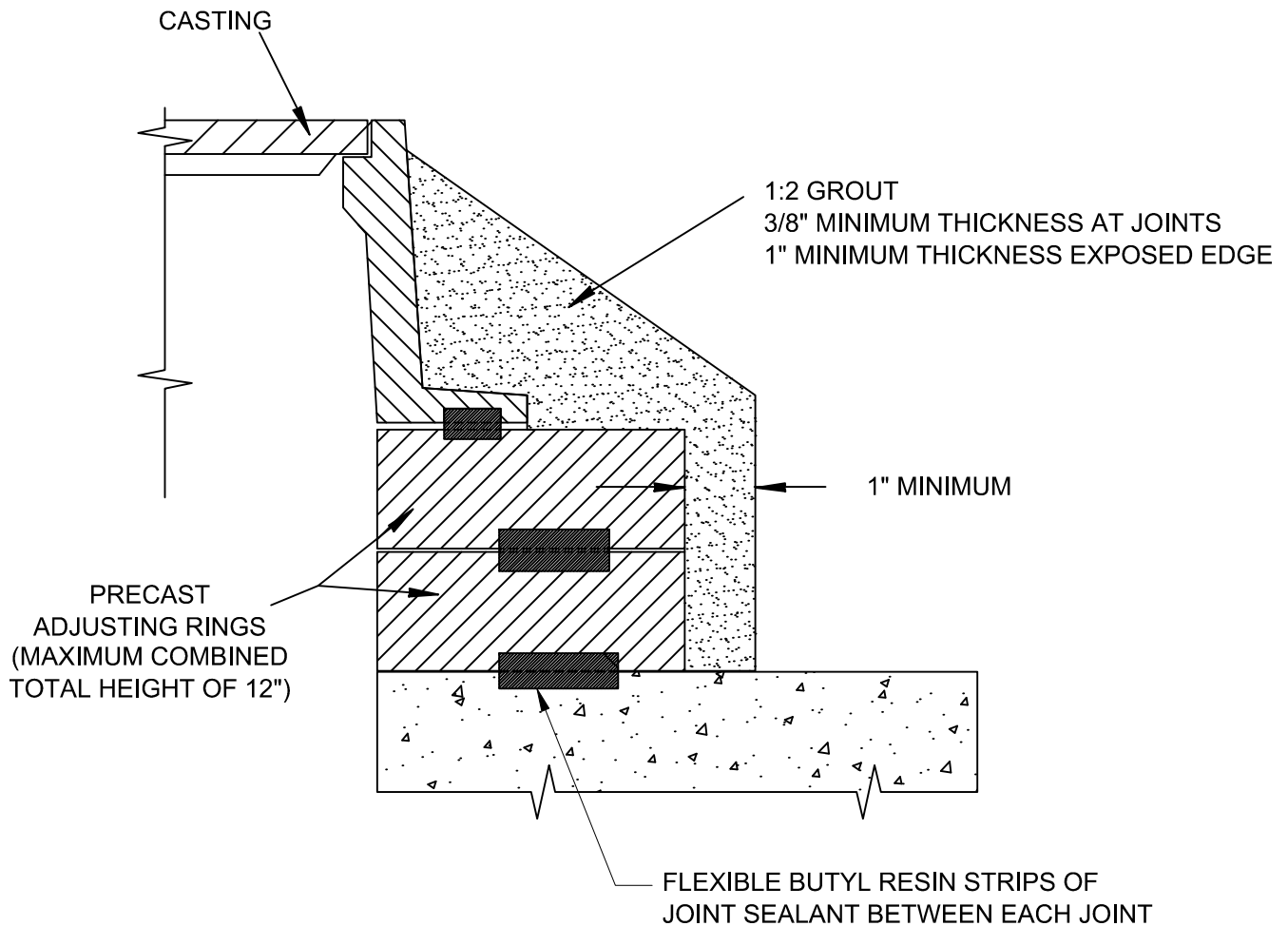
DRAWN BY: M.H. & A.H.W.F.
APPROVED BY: K.N.H.
DATE REVISED: 12/22/97 & 8/11/11

MANHOLE FRAME
& COVER

STANDARD
DRAWING NO.

S - 2

MURFREESBORO WATER & SEWER DEPARTMENT



DRAWING NOT TO SCALE

MARCH 4, 2002

DRAWN BY: M.H. & A.H.W.F.
APPROVED BY: K.N.H.
DATE REVISED: 3/4/02 & 12/30/08

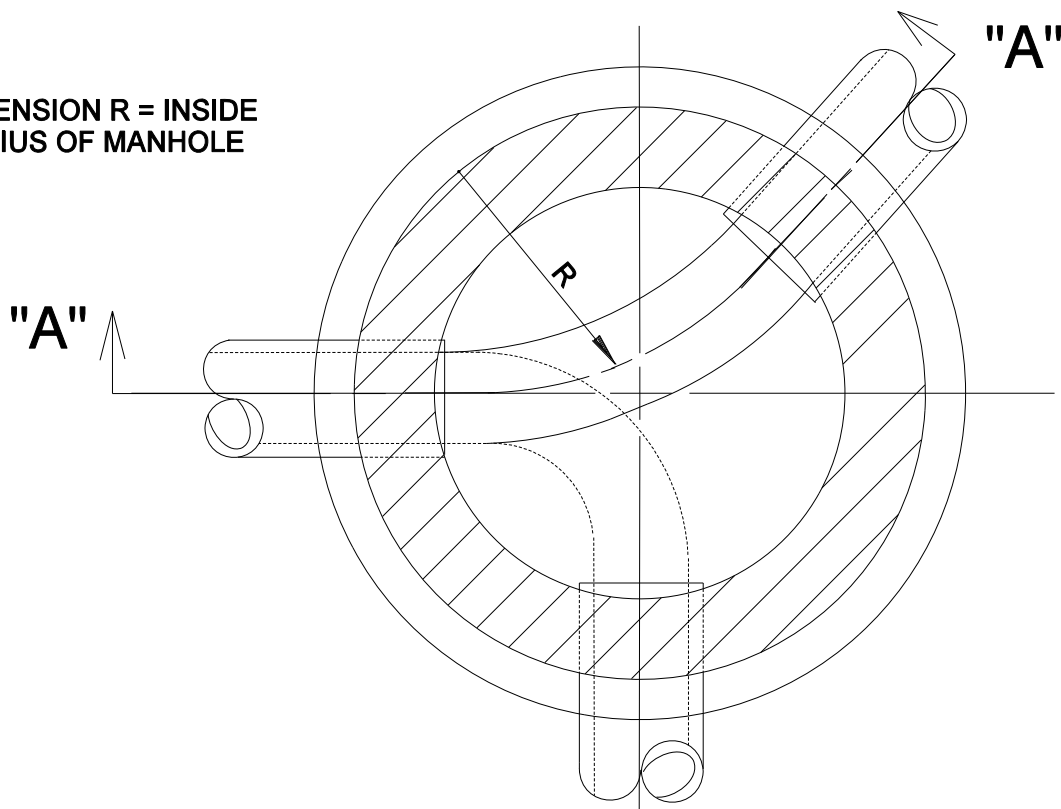
MANHOLE CASTING INSTALLATION

STANDARD
DRAWING NO.

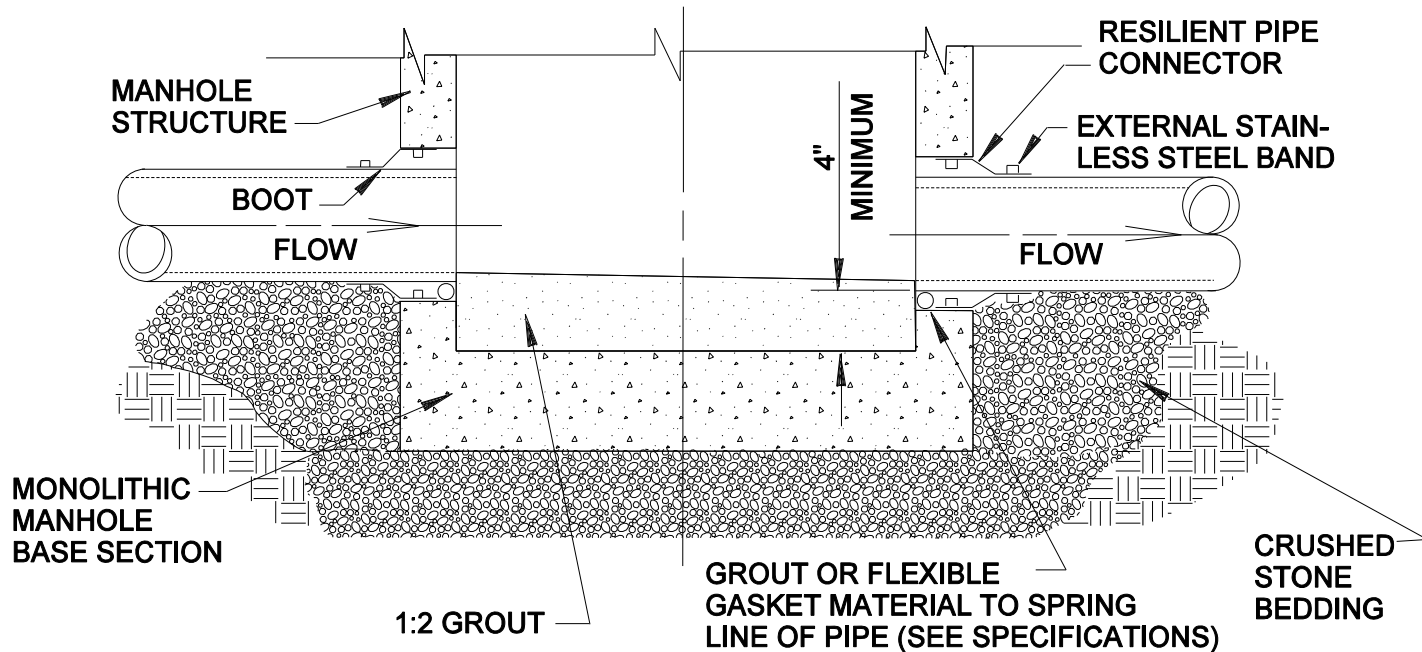
S - 3

MURFREESBORO WATER & SEWER DEPARTMENT

DIMENSION R = INSIDE
RADIUS OF MANHOLE



PLAN



SECTION "A"- "A"

DRAWING NOT TO SCALE

MAY 27, 1994

DRAWN BY: KMC
APPROVED BY: VHS
DATE REVISED: 11/30/05

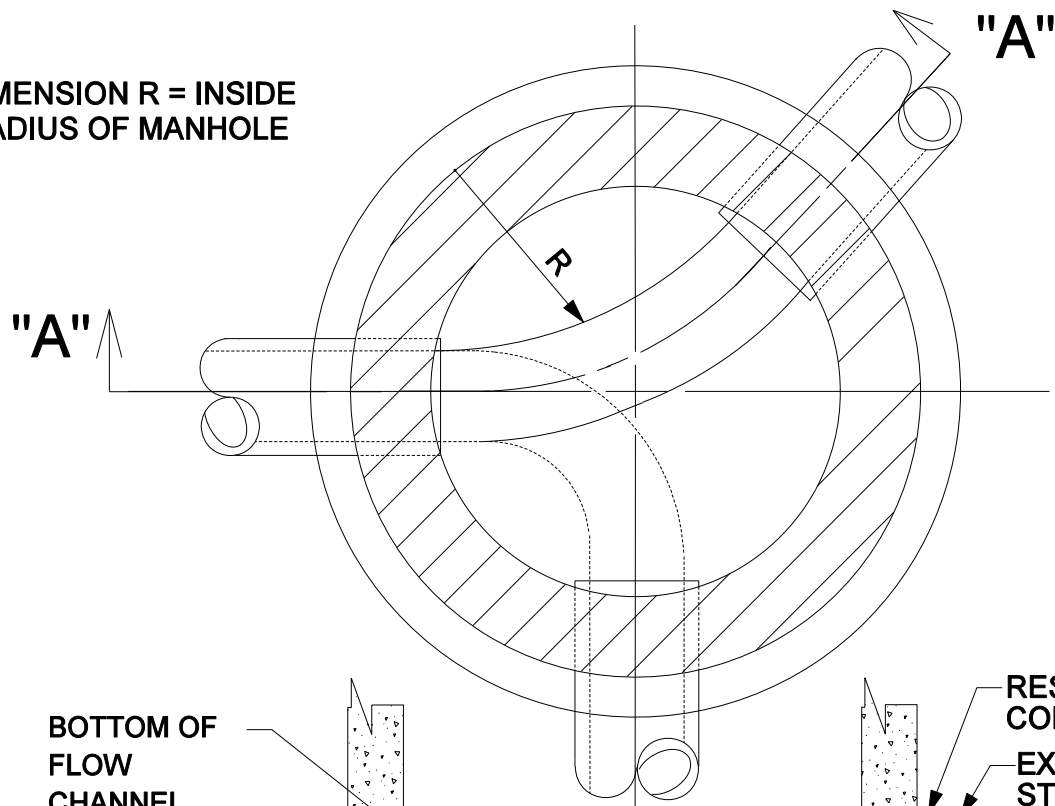
MANHOLE INVERT & PIPE AT WALL

STANDARD
DRAWING NO.

S - 4

MURFREESBORO WATER & SEWER DEPARTMENT

DIMENSION R = INSIDE
RADIUS OF MANHOLE



PLAN

BOTTOM OF
FLOW
CHANNEL

TOP OF BENCH

MANHOLE
STRUCTURE

BOOT

FLOW

RESILIENT PIPE
CONNECTOR

EXTERNAL STAINLESS
STEEL BAND

FLOW

FLEXIBLE GASKET OR
GROUT MATERIAL TO
SPRING LINE OF PIPE
(SEE SPECIFICATIONS)

4" - 15"

MONOLITHIC
MANHOLE
BASE SECTION

1:2 GROUT

CRUSHED
STONE
BEDDING

SECTION "A"-"A"

DRAWING NOT TO SCALE

MAY 27, 1994

DRAWN BY: KMC

APPROVED BY: VHS

DATE REVISED: 11/30/05

MANHOLE INVERT
&
PIPE AT WALL

STANDARD
DRAWING NO.

S - 4A

MURFREESBORO WATER & SEWER DEPARTMENT

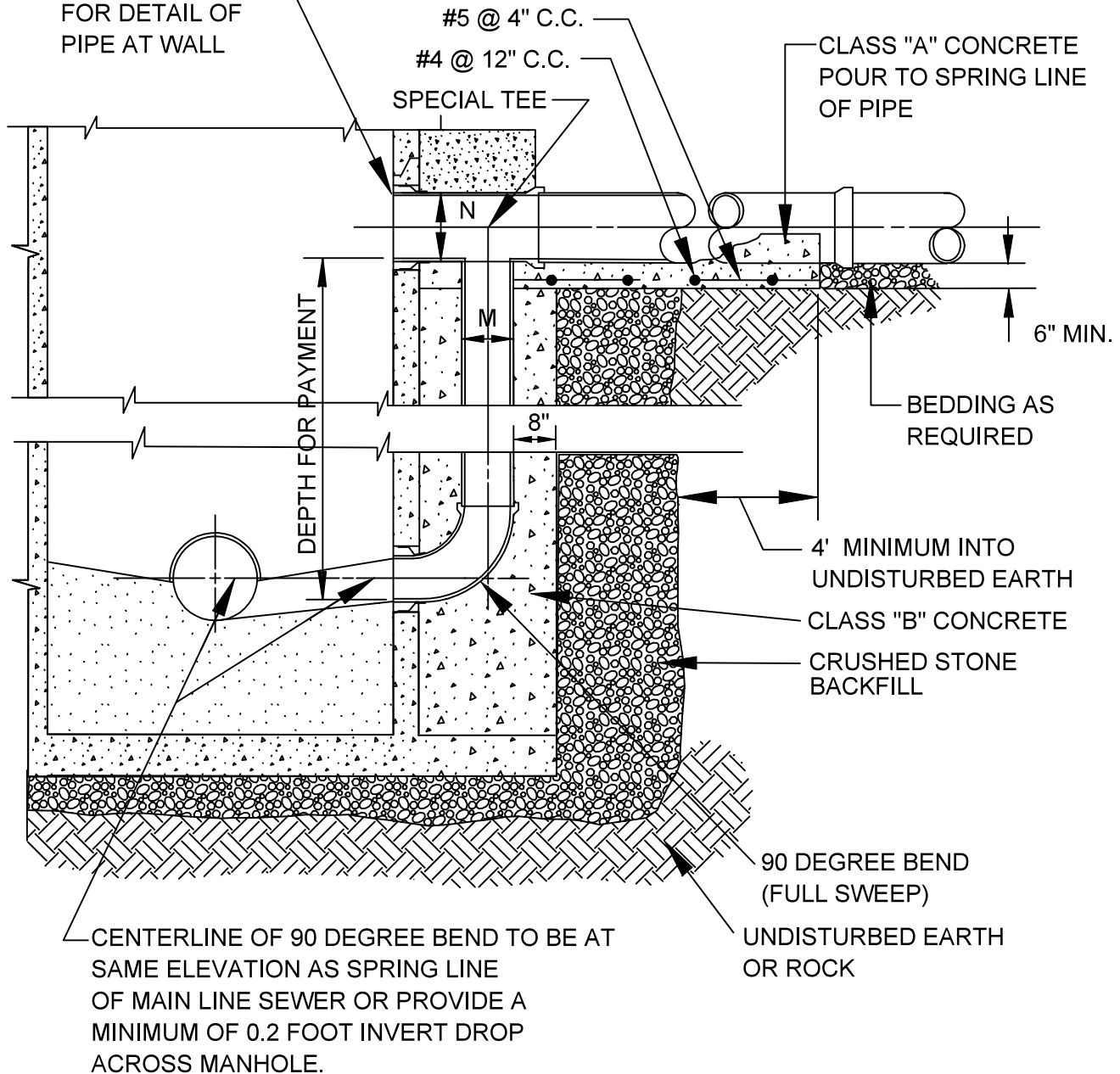
NOTE USE ONLY AS
DIRECTED BY THE ENGINEER.

"M" SHALL BE ONE NOMINAL
SIZE SMALLER THAN "N"

MINIMUM "N" & "M" IS 8"

NOTE DROP ASSEMBLIES
ARE REQUIRED WHERE
THE FALL ACROSS THE
MANHOLE IS GREATER
THAN 15". IF UNDER 15",
SEE S-4A.

SEE DRAWING S-4
FOR DETAIL OF
PIPE AT WALL



DRAWING NOT TO SCALE

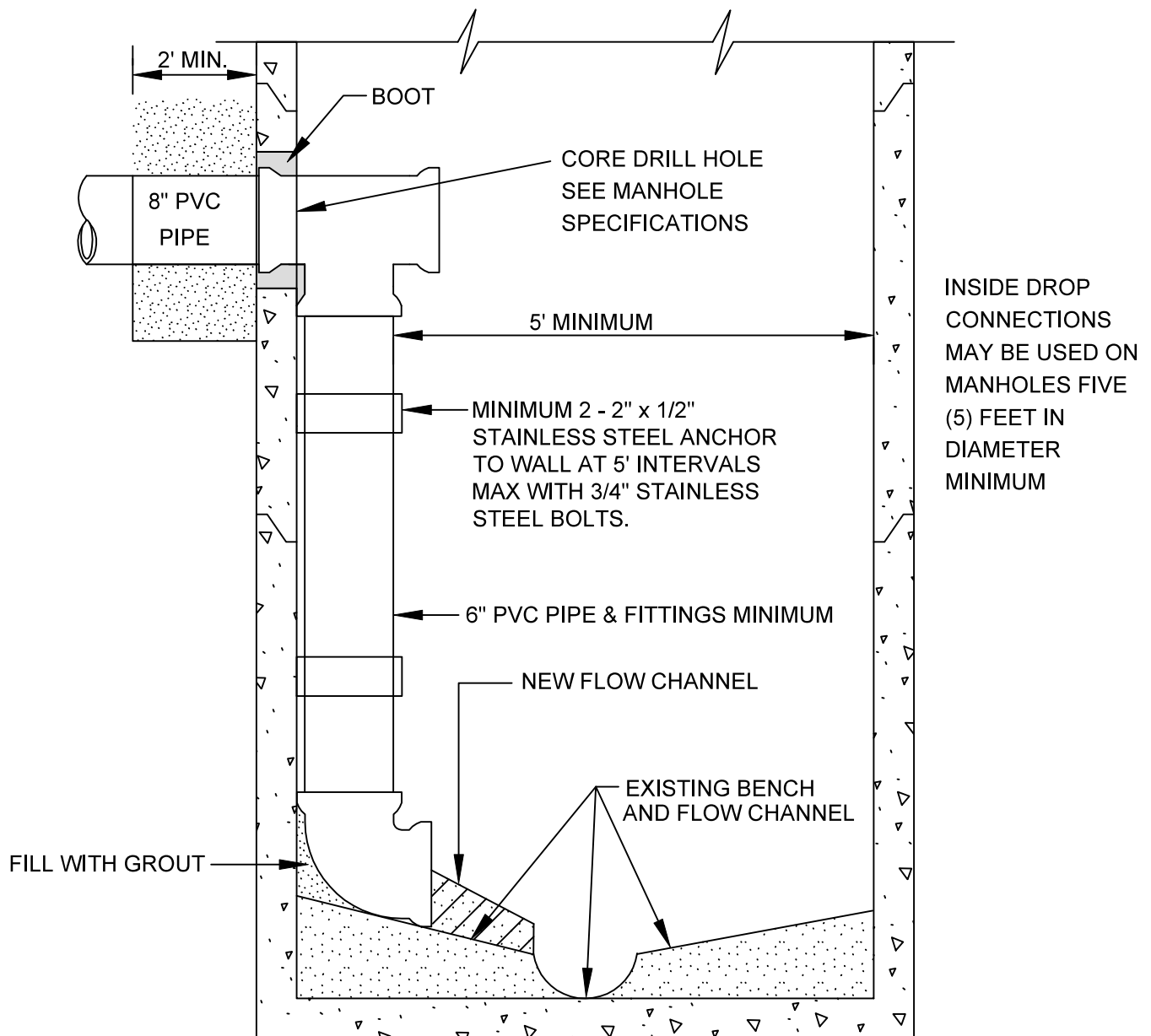
MAY 27, 1994

DRAWN BY: A.H.W.F.
APPROVED BY: K.N.H.
DATE REVISED: 01/28/19 VHS

MANHOLE DROP CONNECTION

STANDARD
DRAWING NO.
S - 10

MURFREESBORO WATER & SEWER DEPARTMENT



DRAWING NOT TO SCALE

MAY 27, 1994

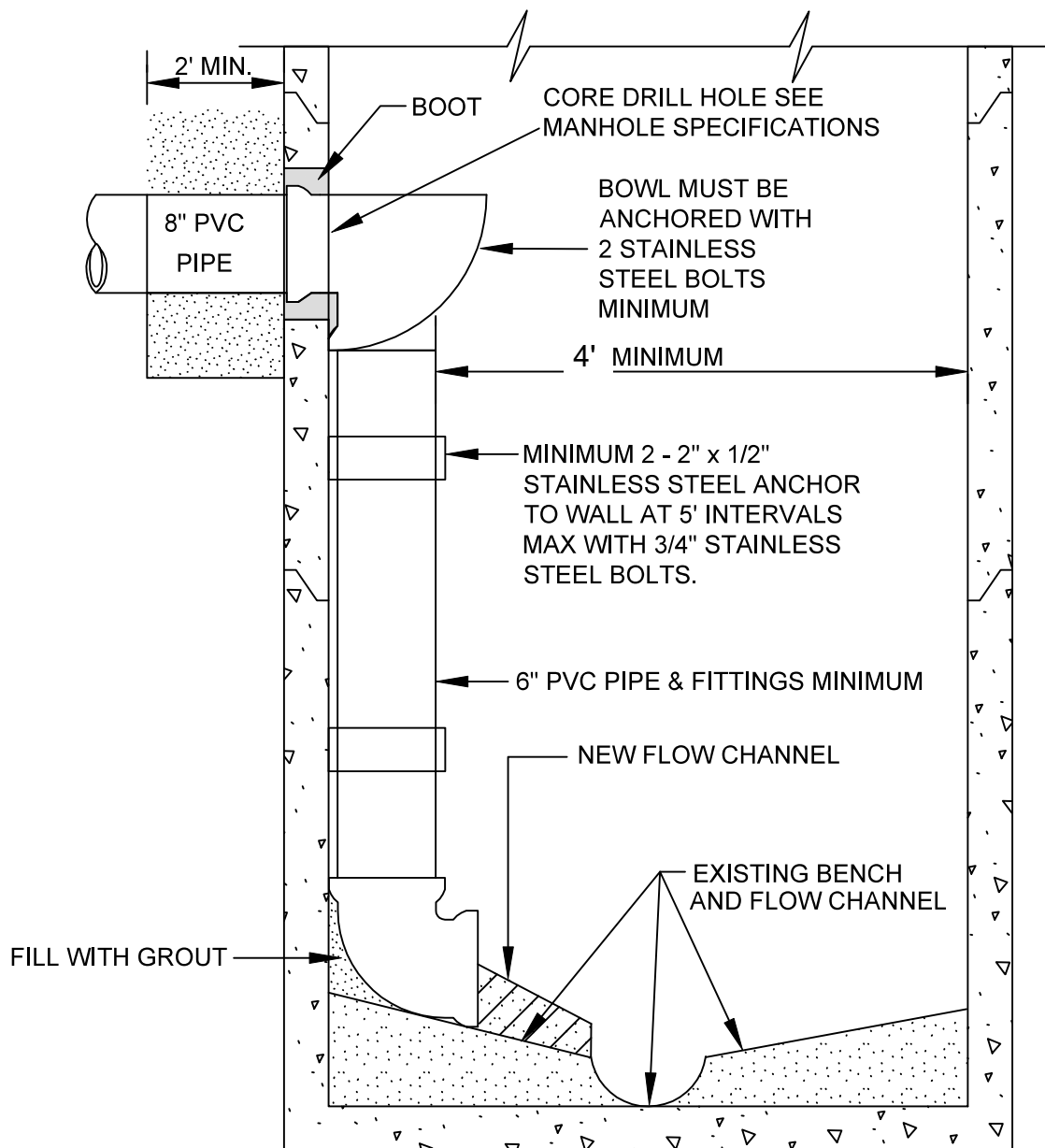
DRAWN BY: KMC
APPROVED BY: VHS
DATE REVISED: 1/29/19 VHS

**INSIDE DROP CONNECTION
AT EXISTING MANHOLE**

STANDARD
DRAWING NO.

S - 11

MURFREESBORO WATER & SEWER DEPARTMENT



DRAWING NOT TO SCALE

FEBRUARY 2019

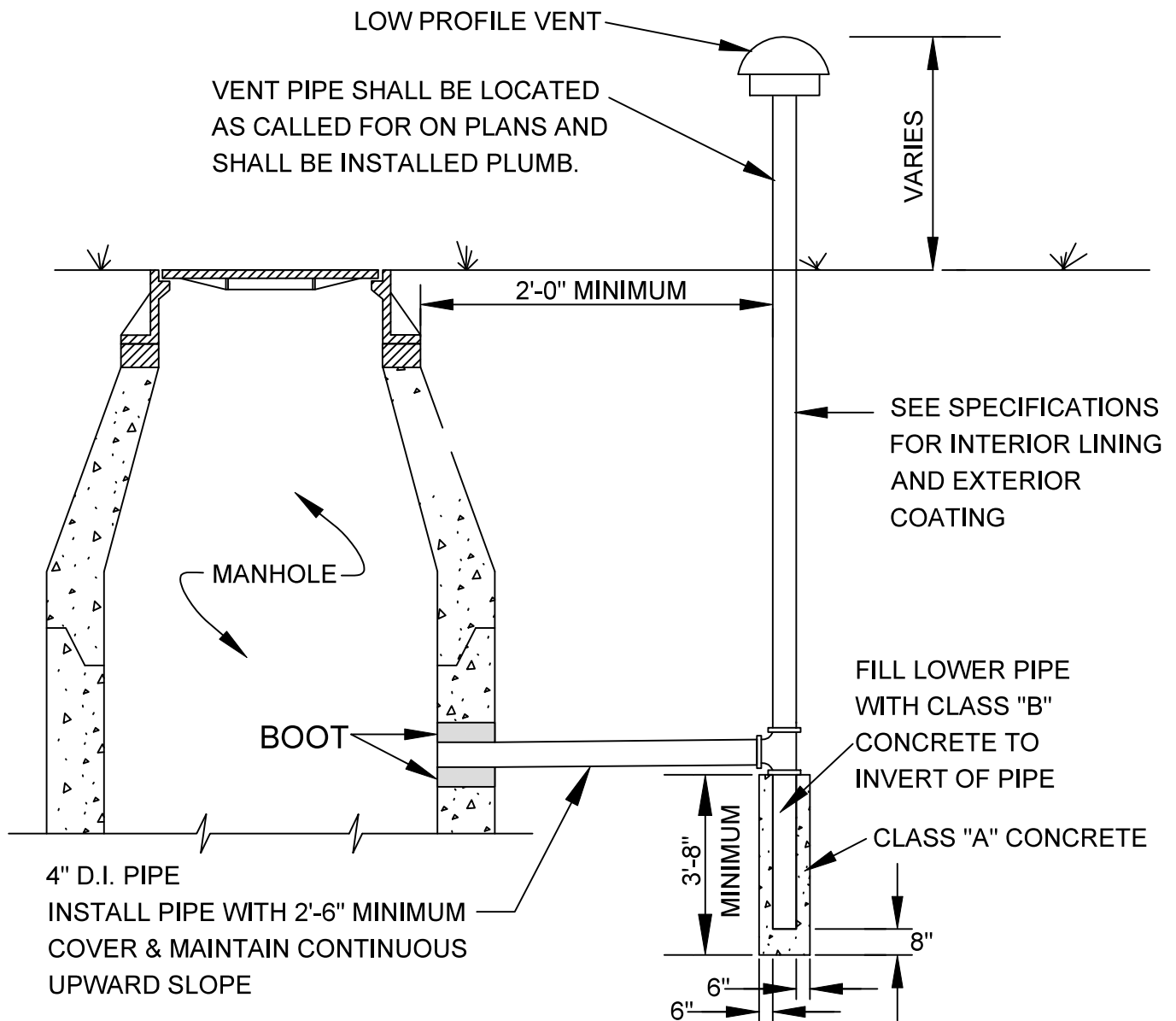
DRAWN BY: VHS
APPROVED BY: VHS

INSIDE DROP BOWL
CONNECTION

STANDARD
DRAWING NO.

S - 11A

MURFREESBORO WATER & SEWER DEPARTMENT



DRAWING NOT TO SCALE

MAY 27, 1994

DRAWN BY: M.H. & A.H.W.F.

APPROVED BY: K.N.H.

DATE REVISED: 1/29/19 VHS

MANHOLE VENT

STANDARD
DRAWING NO.

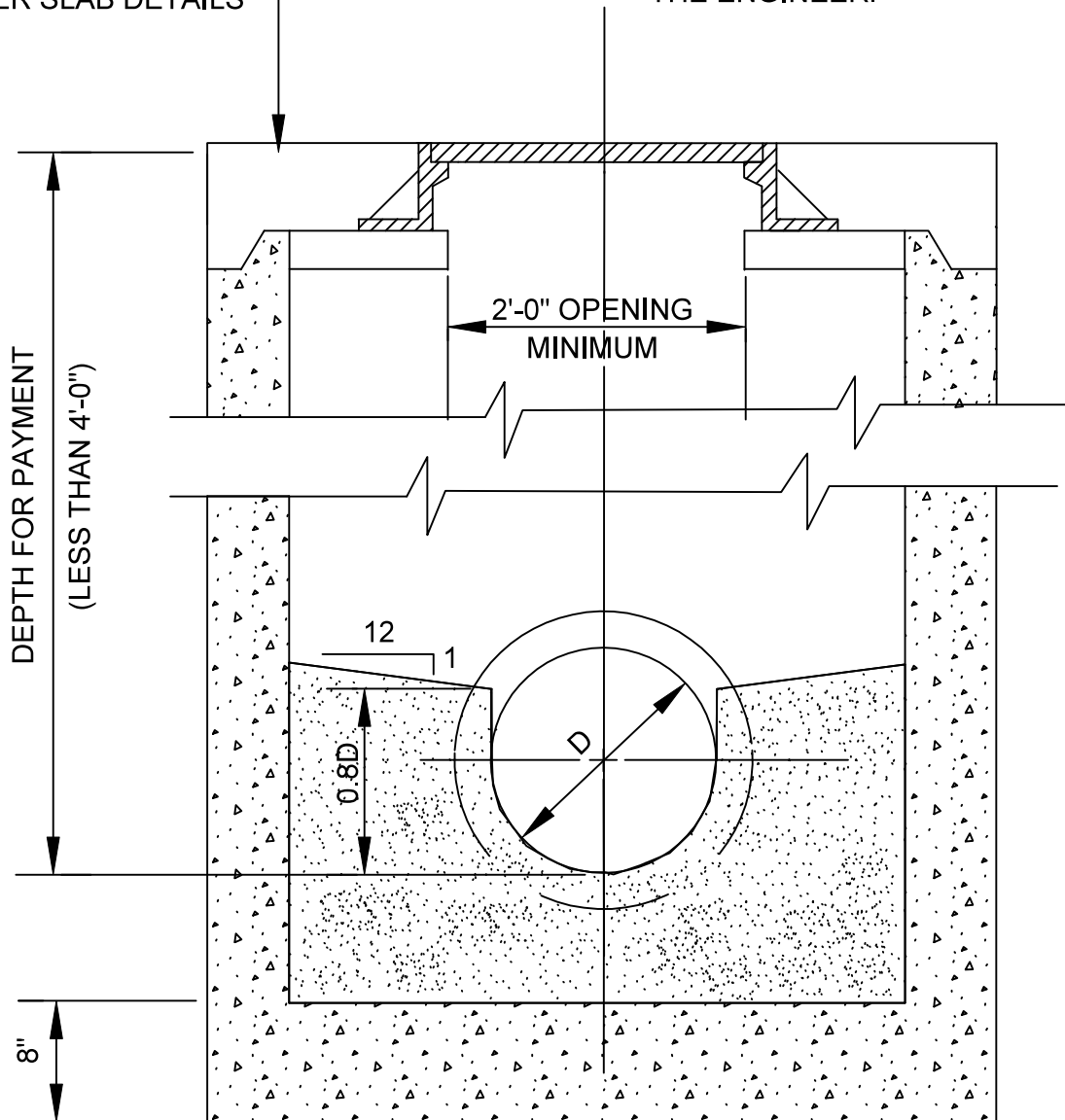
S - 12

MURFREESBORO WATER & SEWER DEPARTMENT

SEE STANDARD DRAWINGS
S-1, S-2, S-3, AND S-4 FOR
ADDITIONAL DETAILS

SEE STANDARD DRAWING
S-13B AND S-13C FOR
COVER SLAB DETAILS

NOTE USE ONLY AS
PREVIOUSLY APPROVED BY
THE ENGINEER.



SECTION

DRAWING NOT TO SCALE

DEC 24, 1997

DRAWN BY: A.H.W.F.
APPROVED BY: B.L.W.
DATE REVISED: 1/28/19 VHS

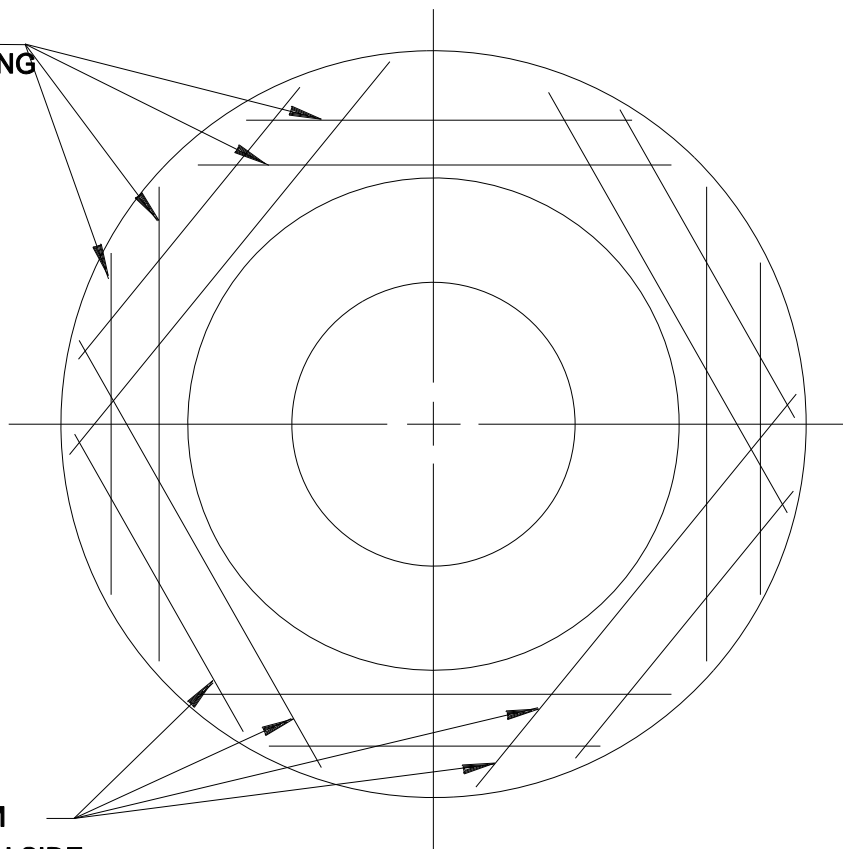
**SHALLOW
MANHOLE**
DRAWING 1 OF 3

STANDARD
DRAWING NO.

S - 13A

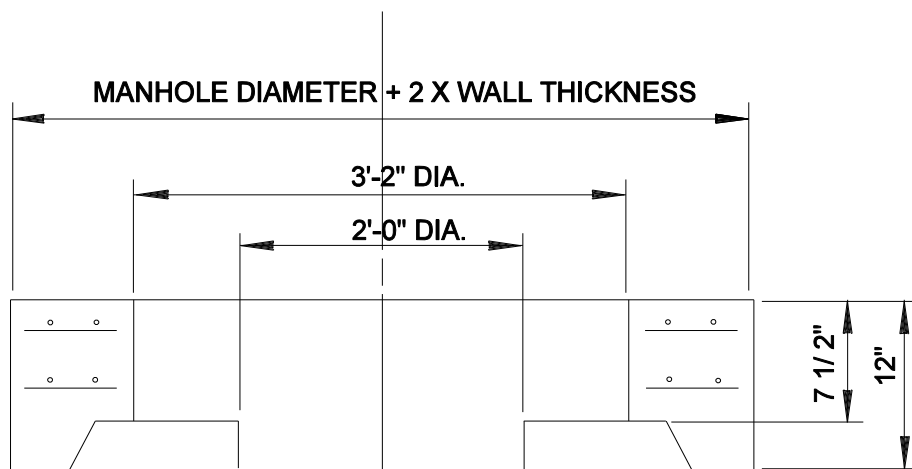
MURFREESBORO WATER & SEWER DEPARTMENT

2 #5 TOP & BOTTOM
EACH SIDE OF OPENING



2 #5 TOP & BOTTOM
ON DIAGONAL EACH SIDE
OF OPENING

COVER SLAB PLAN



COVER SLAB SECTION

DRAWING NOT TO SCALE

DEC 24, 1997

DRAWN BY: A.H.W.F.
APPROVED BY: B.L.W.

**SHALLOW CONCENTRIC
MANHOLE**

DRAWING 2 OF 3

STANDARD
DRAWING NO.

S - 13B

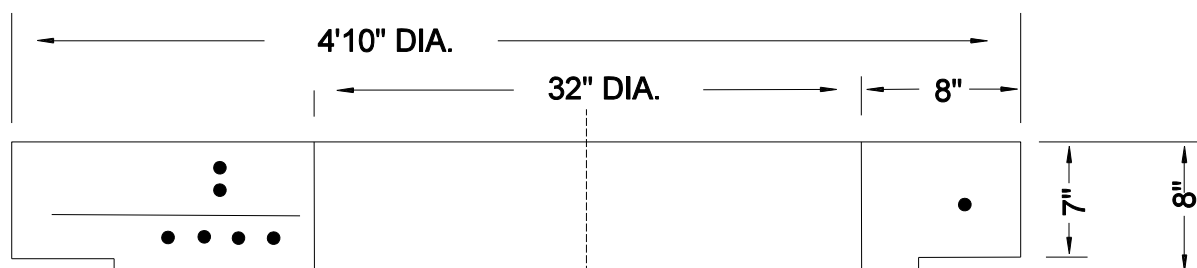
MURFREESBORO WATER & SEWER DEPARTMENT

2 - #3 BAR
IN TOP

1 - #4 BAR
CIRCULAR

4 - #4 BAR
@ 3" C/C

3 - #4 BAR @
2" C/C (TYP)



*NOTE: 12" SLAB TO BE
USED WHEN PRODUCT
HEIGHT ALLOWS.

DRAWING NOT TO SCALE

DEC. 24, 1997

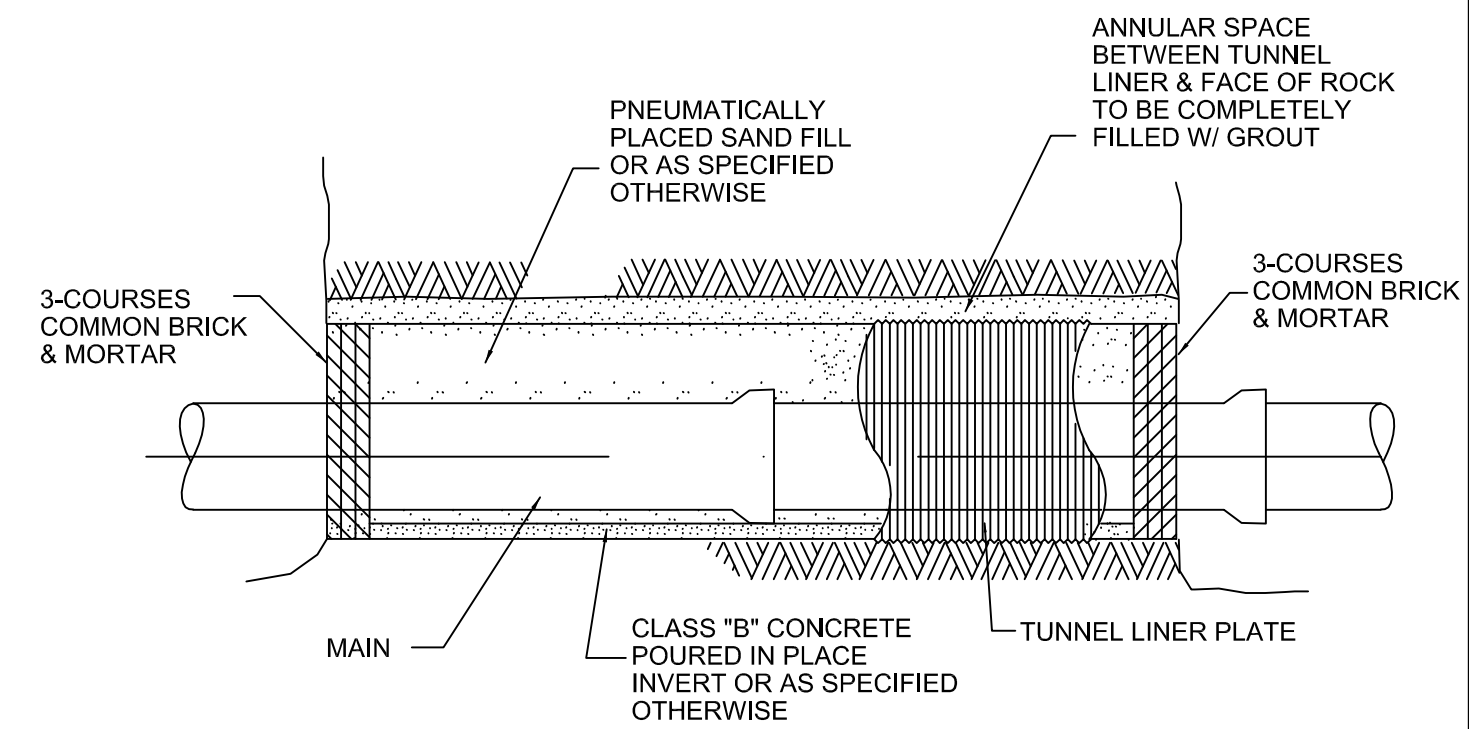
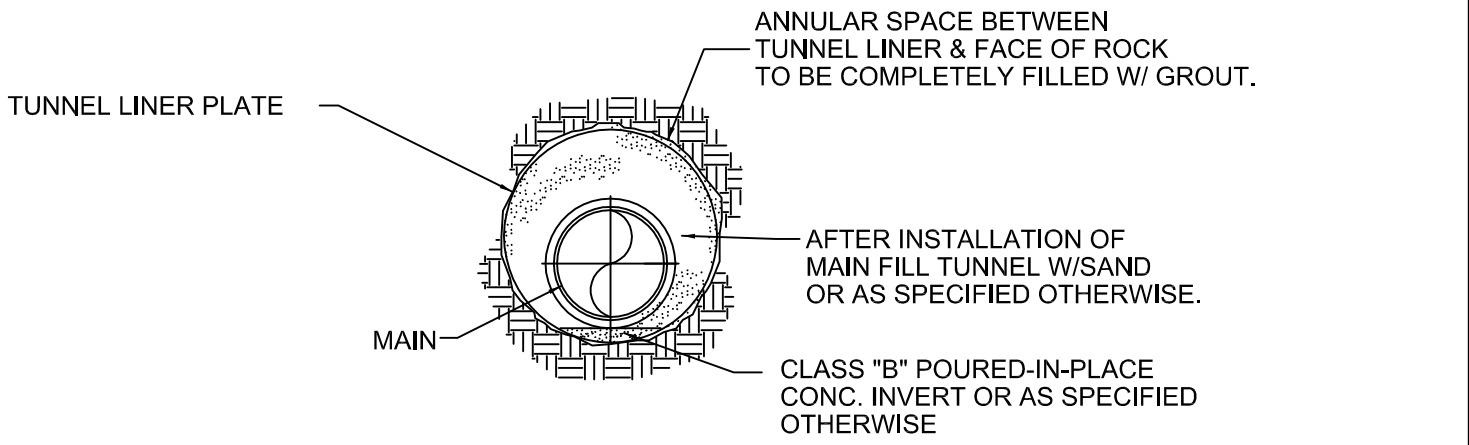
DRAWN BY: T.A.B.
APPROVED BY: B.L.W.

SHALLOW ECCENTRIC
MANHOLE
DRAWING 3 OF 3

STANDARD
DRAWING NO.

S - 13C

MURFREESBORO WATER & SEWER DEPARTMENT



DRAWING NOT TO SCALE

AUGUST 1, 1999

DRAWN BY: KMC
 APPROVED BY: VHS
 DATE REVISED: 11/30/05 & 12/30/08

TUNNEL DETAIL

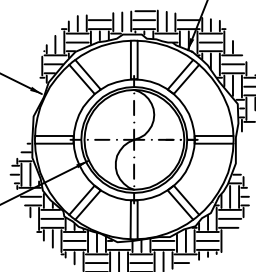
STANDARD
 DRAWING NO.
S - 15

MURFREESBORO WATER & SEWER DEPARTMENT

STEEL CASING PIPE
WITH SPACERS FOR
PIPE ON GRADE.

MAIN

ANNULAR SPACE BETWEEN
CASING & FACE OF ROCK
TO BE COMPLETELY FILLED W/ GROUT.

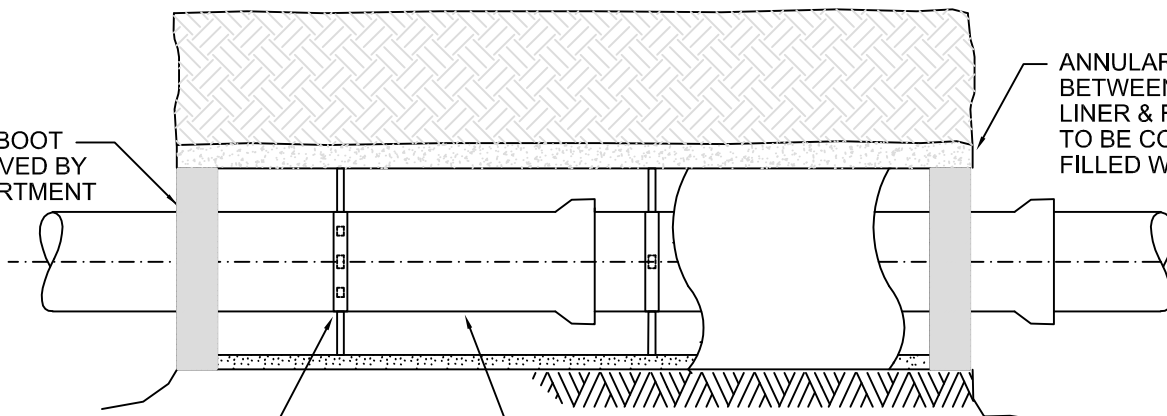


FLEXIBLE BOOT
AS APPROVED BY
THE DEPARTMENT

ANNULAR SPACE
BETWEEN CASING
LINER & FACE OF ROCK
TO BE COMPLETELY
FILLED W/ GROUT

STAINLESS STEEL
BANDED PIPE SPACER
(TYP.)

MAIN



DRAWING NOT TO SCALE

NOVEMBER 13, 2009

DRAWN BY: KAC
APPROVED BY: VHS

CASING DETAIL

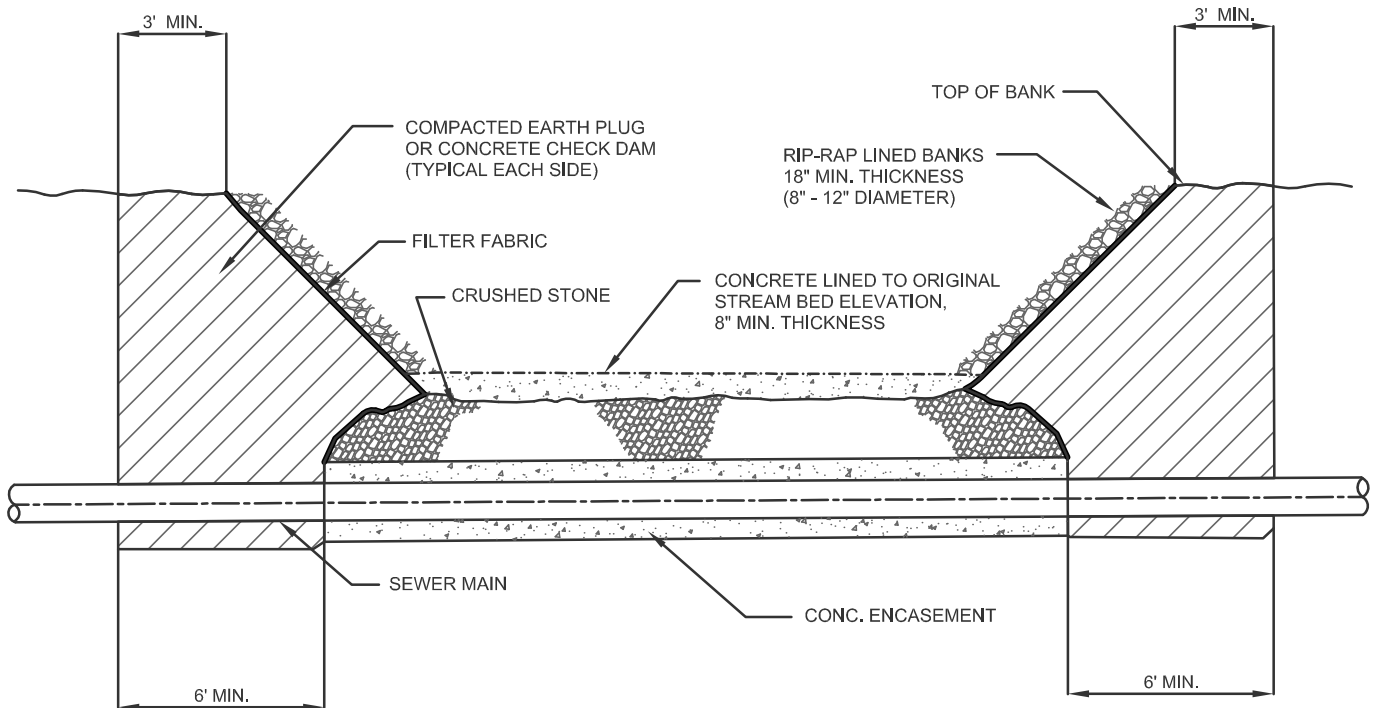
STANDARD
DRAWING NO.

S - 15A

MURFREESBORO WATER & SEWER DEPARTMENT

NOTE

FOR EXCAVATION IN SOLID ROCK, THE TRENCH MUST BE LINE DRILLED
AND PRE-SPLIT. SEE SPECS FOR OTHER SPECIAL CONDITIONS.



DRAWING NOT TO SCALE

NOVEMBER 18, 2009

DRAWN BY: KAC
APPROVED BY: VHS
DATE REVISED:

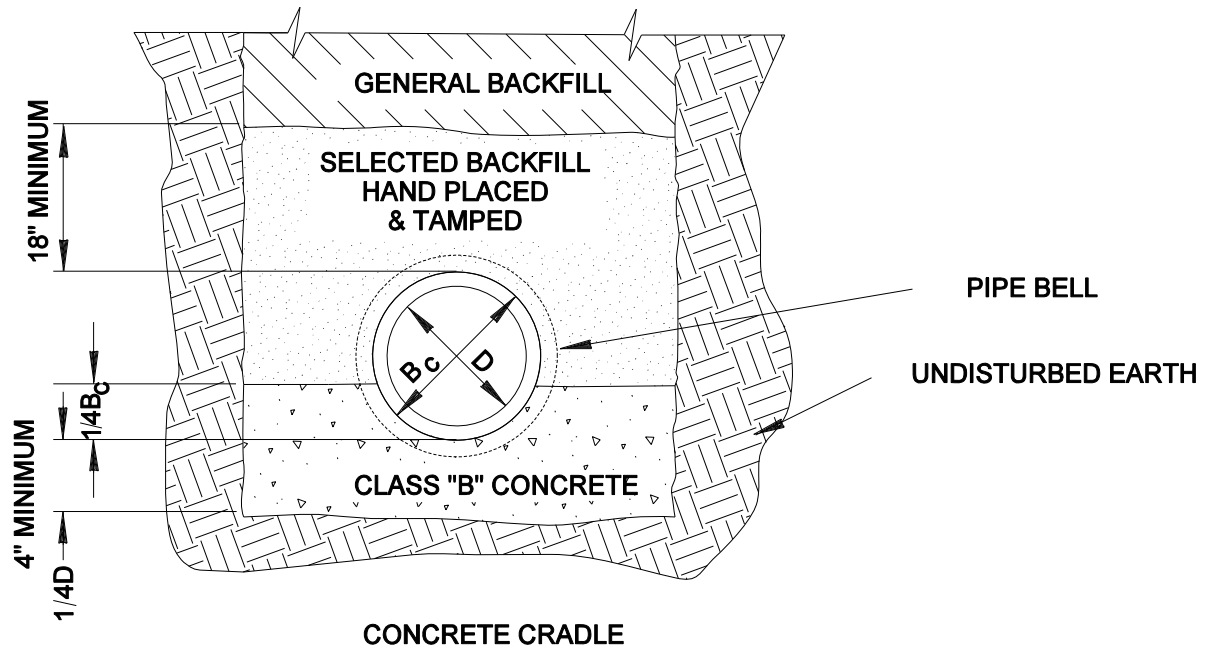
STREAM CROSSING DETAIL

STANDARD
DRAWING NO.

S - 16

MURFREESBORO WATER & SEWER DEPARTMENT

BACKFILL IN PAVED AREAS SHALL BE
CRUSHED STONE. SEE SPECIFICATIONS.



NOTES:

- 1) DETAIL IS APPLICABLE TO EARTH TRENCHES.
- 2) SEE STANDARD DRAWINGS S-20B & S-20C FOR ADDITIONAL BEDDING DETAILS.

CLASS "A" BEDDING

CLASS "A" BEDDING
FOR GRAVITY SEWERS
SHALL BE USED ONLY
WHERE INDICATED,
SPECIFIED OR AUTHORIZED

DRAWING NOT TO SCALE

MAY 27, 1994

DRAWN BY: M.H. & A.H.W.F.
APPROVED BY: K.N.H.

BEDDING DETAILS

DRAWING 1 OF 3

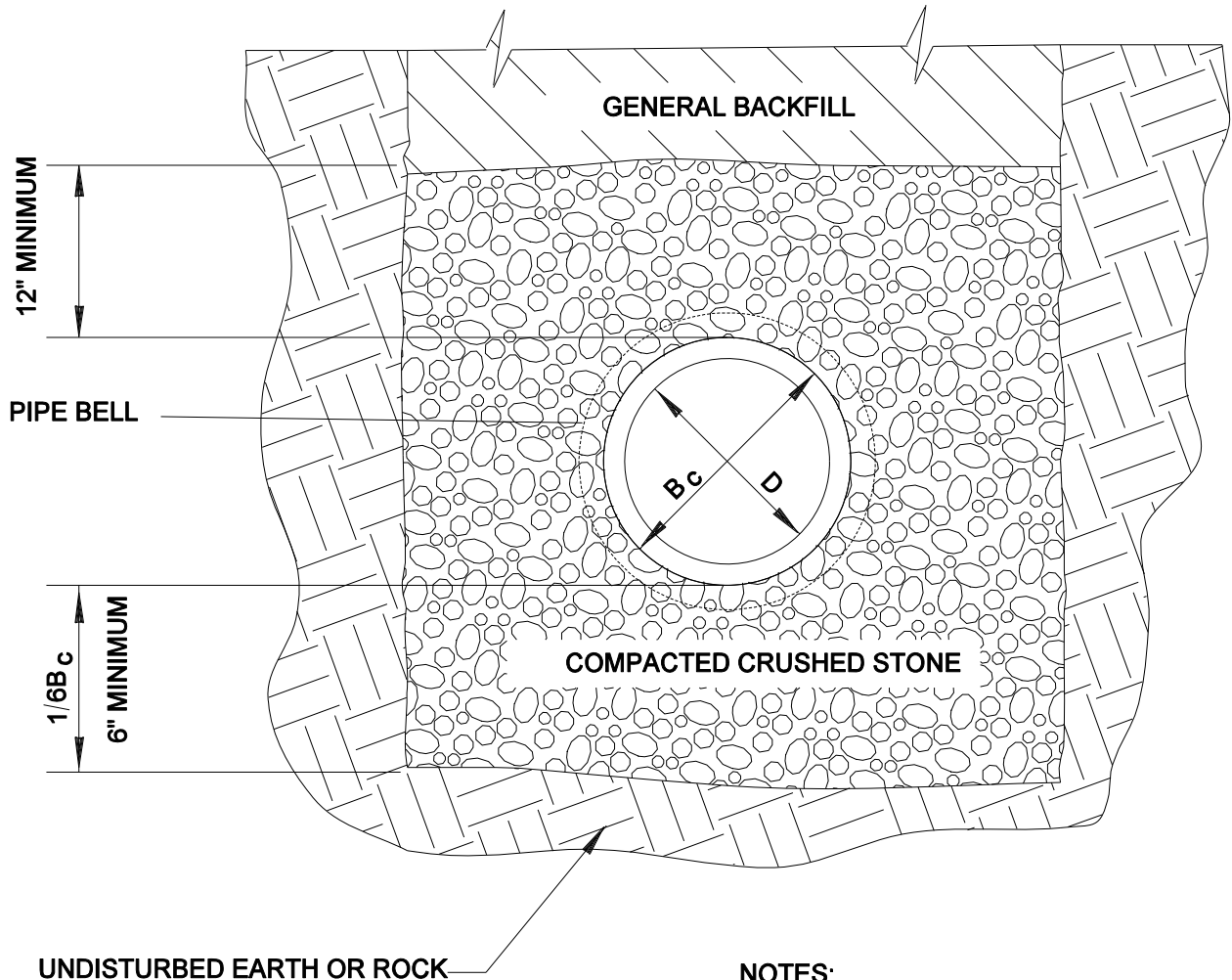
STANDARD
DRAWING NO.

S - 20A

MURFREESBORO WATER & SEWER DEPARTMENT

DATE REVISED:

BACKFILL IN PAVED AREAS SHALL BE
CRUSHED STONE. SEE SPECIFICATIONS.



ALL PVC GRAVITY SEWER
PIPE SHALL BE INSTALLED
ON CLASS "B" BEDDING
UNLESS OTHERWISE
INDICATED OR AUTHORIZED.

NOTES:

- 1) DETAILS ARE APPLICABLE TO BOTH EARTH & ROCK TRENCHES.
- 2) COMPACTED CRUSHED STONE SHALL BE SIZE NO. 67 AS GIVEN IN SECTION 903 OF THE T.D.O.T. STANDARD SPECIFICATIONS FOR ROAD & BRIDGE CONSTRUCTION.
- 3) SEE STANDARD DRAWINGS S-20A & S-20C FOR ADDITIONAL BEDDING DETAILS.

CLASS "B" BEDDING

DRAWING NOT TO SCALE

MAY 27, 1994

DRAWN BY: M.H. & A.H.W.F.
APPROVED BY: K.N.H.

BEDDING DETAILS

DRAWING 2 OF 3

STANDARD
DRAWING NO.

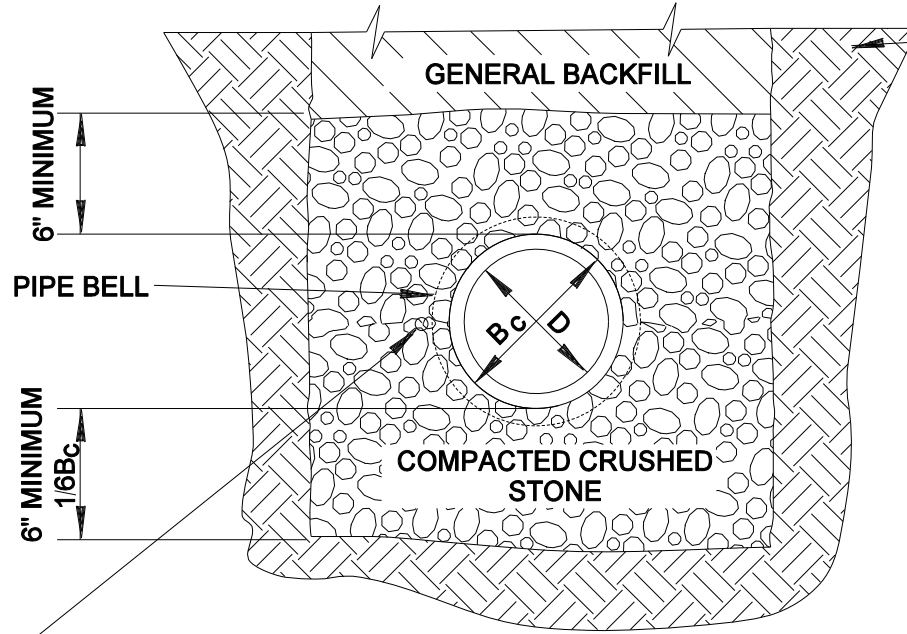
S - 20B

MURFREESBORO WATER & SEWER DEPARTMENT

DATE REVISED:

BACKFILL IN PAVED AREAS SHALL BE
CRUSHED STONE. SEE SPECIFICATIONS.

UNDISTURBED EARTH OR ROCK



ONE 14 TW SOLID
COPPER WIRE WITH
WHITE COATING
(FOR PVC FORCE MAIN)

CLASS "C-1"

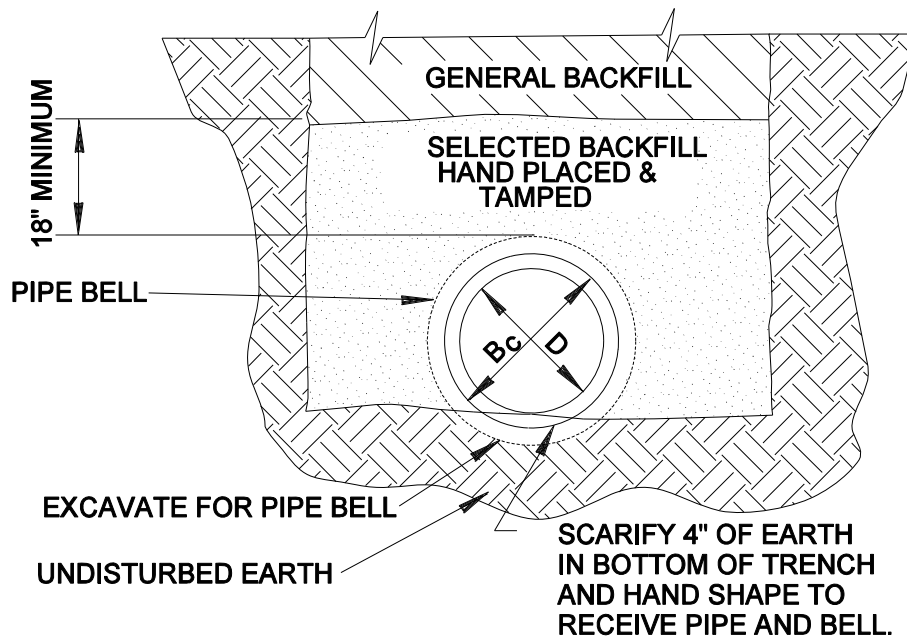
NOTES (CLASS "C-1"):

- 1) DETAIL IS APPLICABLE TO BOTH EARTH & ROCK TRENCHES. EXCEPT AS NOTED IN 4).
- 2) COMPACTED CRUSHED STONE SHALL BE SIZE NO. 67 AS GIVEN IN SECTION 903 OF THE T.D.O.T. STANDARD SPECIFICATIONS FOR ROAD & BRIDGE CONSTRUCTION.
- 3) UNLESS OTHERWISE INDICATED OR AUTHORIZED, ALL GRAVITY SEWER PIPE, EXCEPT PVC PIPE SHALL BE INSTALLED ON CLASS "C-1" BEDDING
- 4) UNLESS OTHERWISE INDICATED OR AUTHORIZED ALL PVC FORCE MAIN OR DUCTILE IRON FORCE MAIN PIPES INSTALLED IN ROCK TRENCHES SHALL BE INSTALLED ON CLASS "C-1" BEDDING

SEE DRAWINGS S-20A & S-20B
FOR ADDITIONAL BEDDING DETAILS.

NOTES (CLASS "C-2"):

- 1) DETAIL IS APPLICABLE TO ONLY DRY, EARTH TRENCHES
- 2) UNLESS OTHERWISE INDICATED OR AUTHORIZED ALL DUCTILE IRON FORCE MAIN PIPE INSTALLED IN EARTH TRENCHES SHALL BE INSTALLED ON CLASS "C-2" BEDDING
- 3) CLASS "C-2" BEDDING SHALL NOT BE USED FOR GRAVITY SEWER



CLASS "C-2"

CLASS "C" BEDDING

DRAWING NOT TO SCALE

MAY 27, 1994

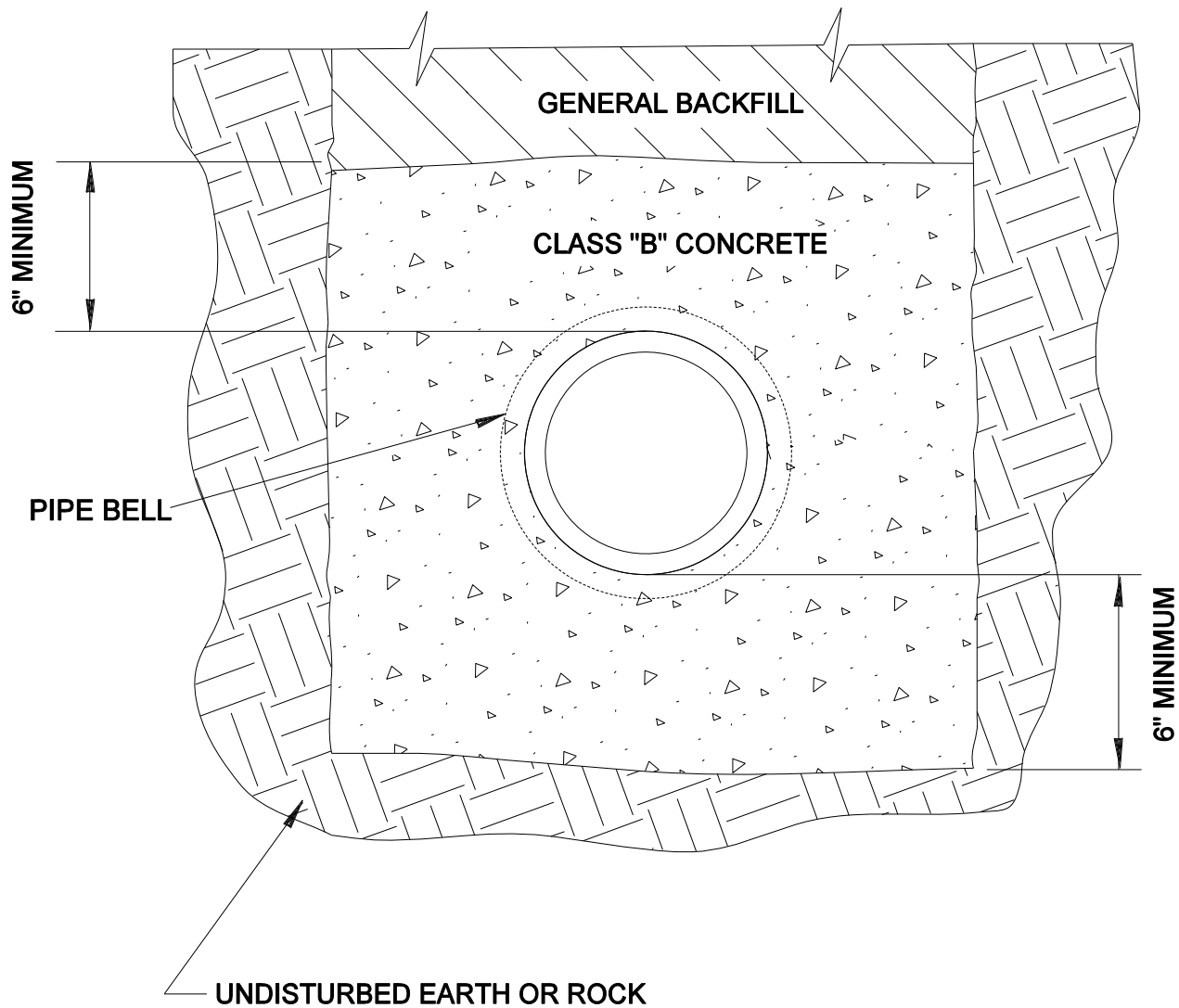
DRAWN BY: M.H. & A.H.W.F.
APPROVED BY: K.N.H.

BEDDING DETAILS
DRAWING 3 OF 3

STANDARD
DRAWING NO.
S - 20C

MURFREESBORO WATER & SEWER DEPARTMENT

BACKFILL IN PAVED AREAS SHALL BE
CRUSHED STONE. SEE SPECIFICATIONS.



DRAWING NOT TO SCALE

MAY 27, 1994

DRAWN BY: M.H. & A.H.W.F.

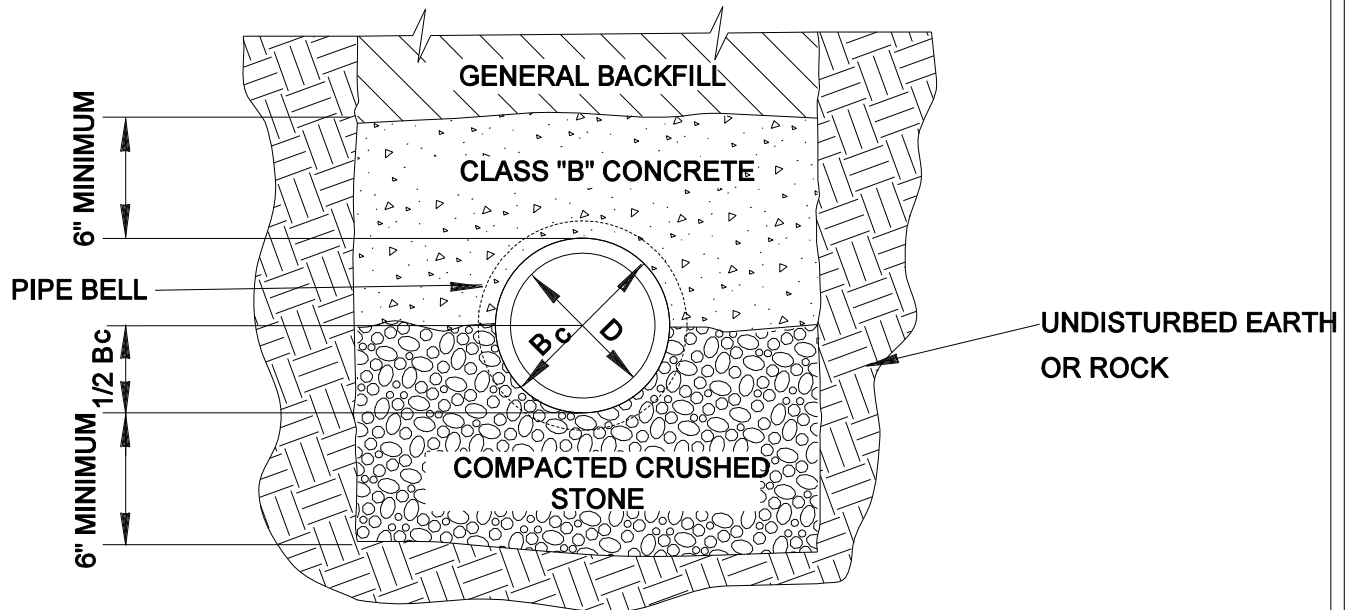
APPROVED BY: K.N.H.

CONCRETE ENCASEMENT

STANDARD
DRAWING NO.
S - 21

MURFREESBORO WATER & SEWER DEPARTMENT

BACKFILL IN PAVED AREAS SHALL BE
CRUSHED STONE. SEE SPECIFICATIONS.



NOTES:

- 1) DETAILS ARE APPLICABLE TO BOTH EARTH & ROCK TRENCHES.
- 2) COMPACTED CRUSHED STONE SHALL BE SIZE NO. 67 AS GIVEN IN SECTION 903 OF THE T.D.O.T. STANDARD SPECIFICATIONS FOR ROAD & BRIDGE CONSTRUCTION.

DRAWING NOT TO SCALE

MAY 27, 1994

DRAWN BY: M.H. & A.H.W.F.
APPROVED BY: K.N.H.

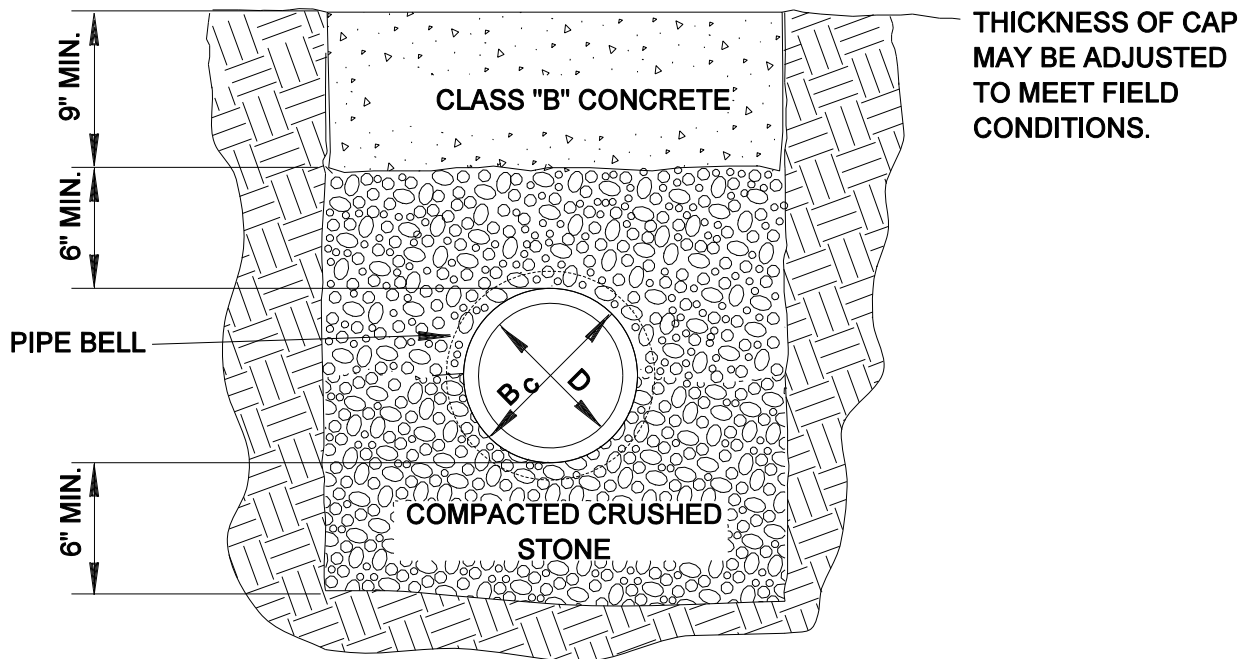
CONCRETE ARCH ENCASEMENT

STANDARD
DRAWING NO.

S - 22

MURFREESBORO WATER & SEWER DEPARTMENT

BACKFILL IN PAVED AREAS SHALL BE
CRUSHED STONE. SEE SPECIFICATIONS.



NOTES:

- 1) DETAILS ARE APPLICABLE TO BOTH EARTH & ROCK TRENCHES.
- 2) COMPACTED CRUSHED STONE SHALL BE SIZE NO. 67 AS GIVEN IN SECTION 903 OF THE T.D.O.T. STANDARD SPECIFICATIONS FOR ROAD & BRIDGE CONSTRUCTION.

DRAWING NOT TO SCALE

MAY 27. 1994

DRAWN BY: M.H. & A.H.W.F.
APPROVED BY: K.N.H.

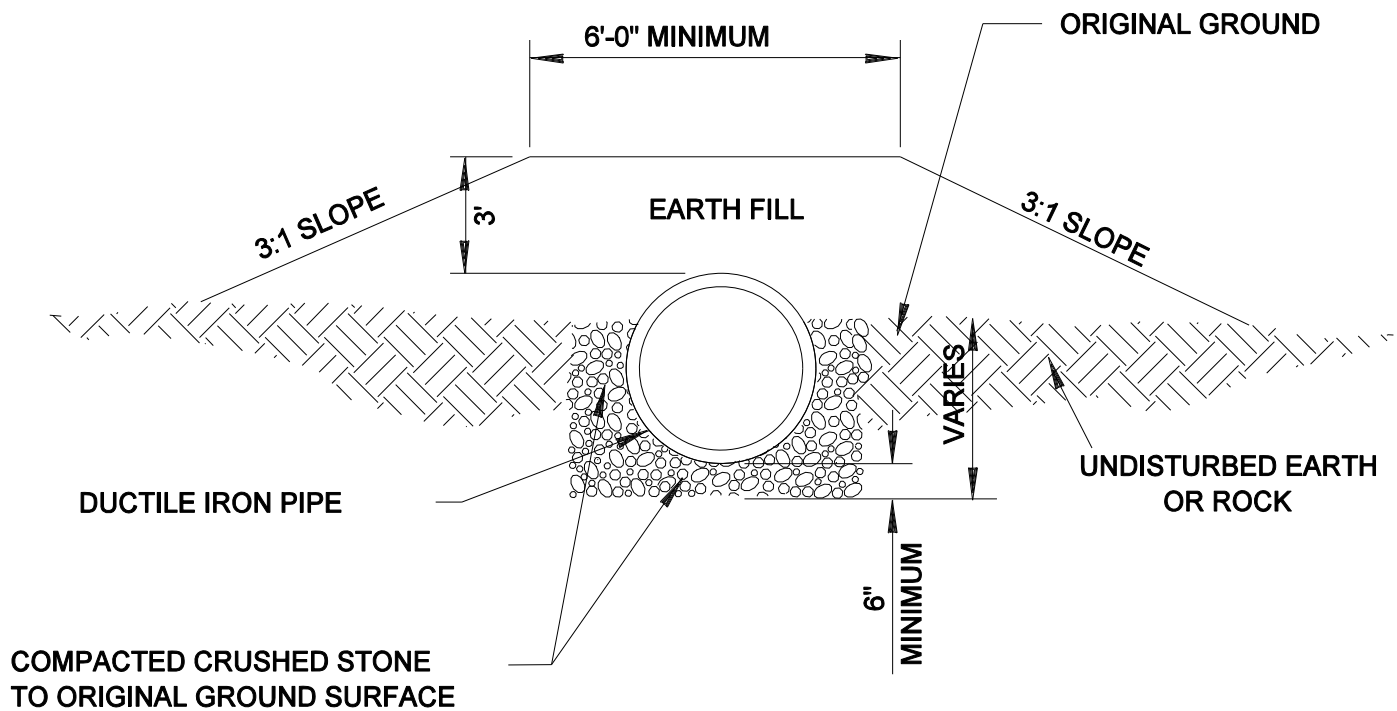
CONCRETE CAP

STANDARD
DRAWING NO.

S - 23

MURFREESBORO WATER & SEWER DEPARTMENT

MINIMUM COVER IS 3'
EXCEPT IN ROADWAY
WHERE IT IS 4.0'.



SEE SPECIFICATIONS FOR TRENCH WIDTH.

DRAWING NOT TO SCALE

MAY 27, 1994

DRAWN BY: KMC

APPROVED BY: VHS

DATE REVISED: 11/30/05

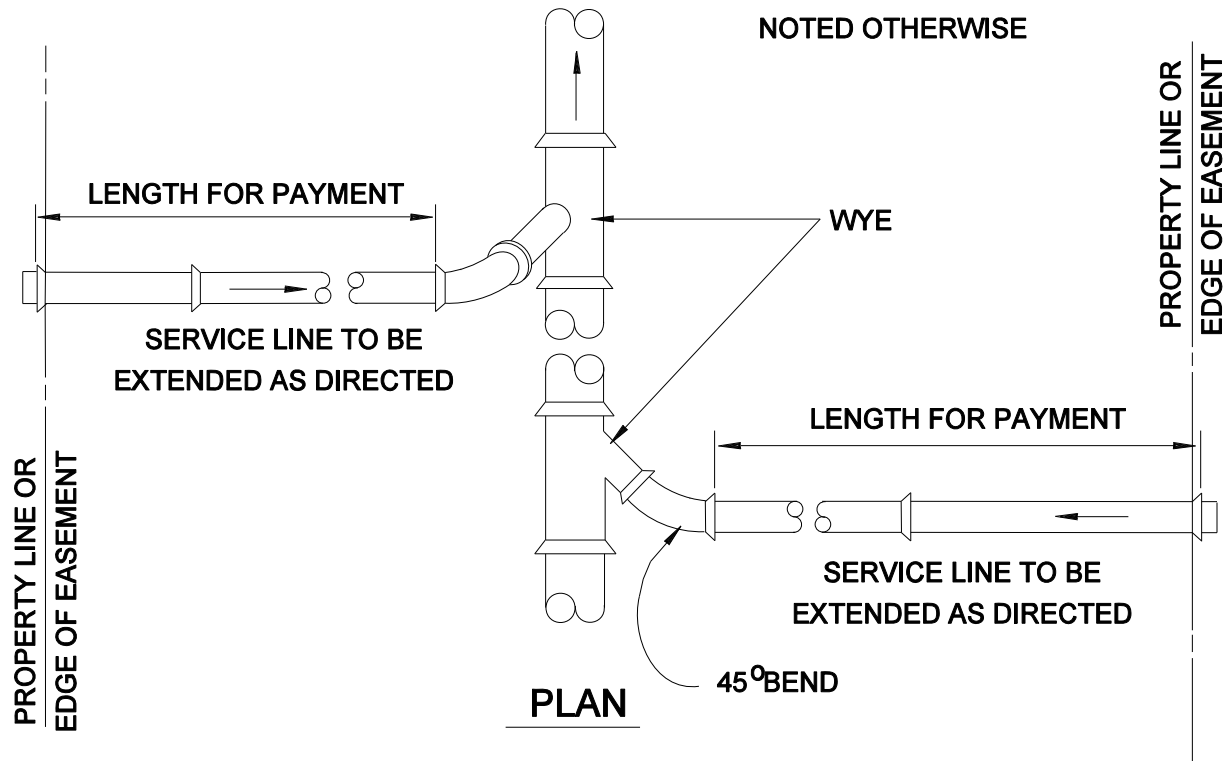
EARTH FILL OVER SANITARY SEWER

STANDARD
DRAWING NO.

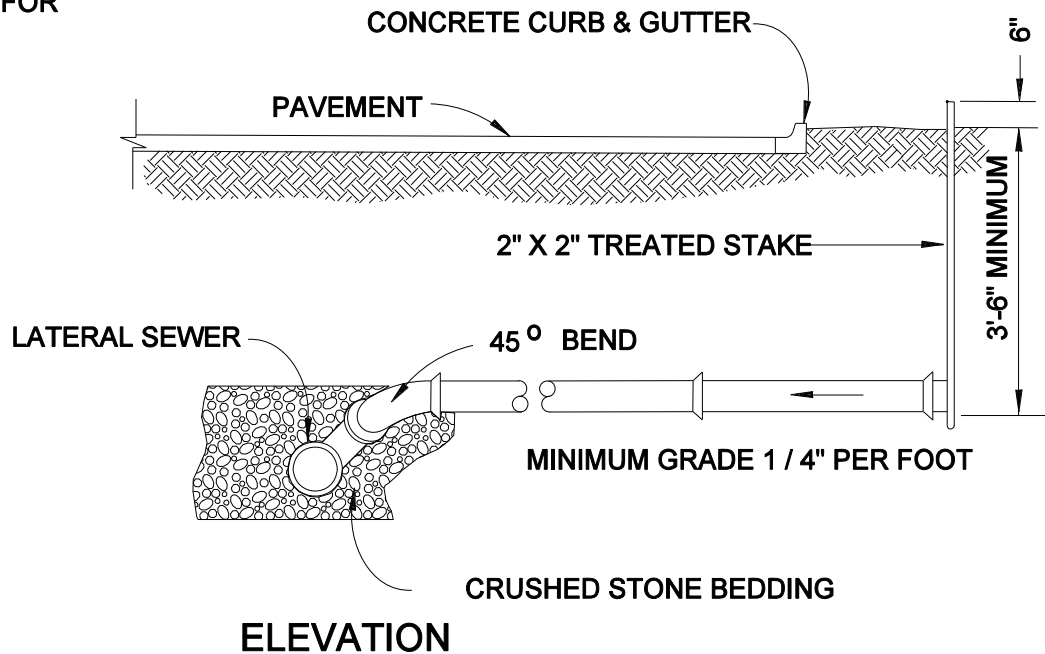
S - 24

MURFREESBORO WATER & SEWER DEPARTMENT

ALL SERVICE LINES
SHALL BE 6" UNLESS
NOTED OTHERWISE



SEE DRAWING S-30B FOR
SERVICE LINE USING
CHIMNEY RISERS



DRAWING NOT TO SCALE

MAY 27, 1994

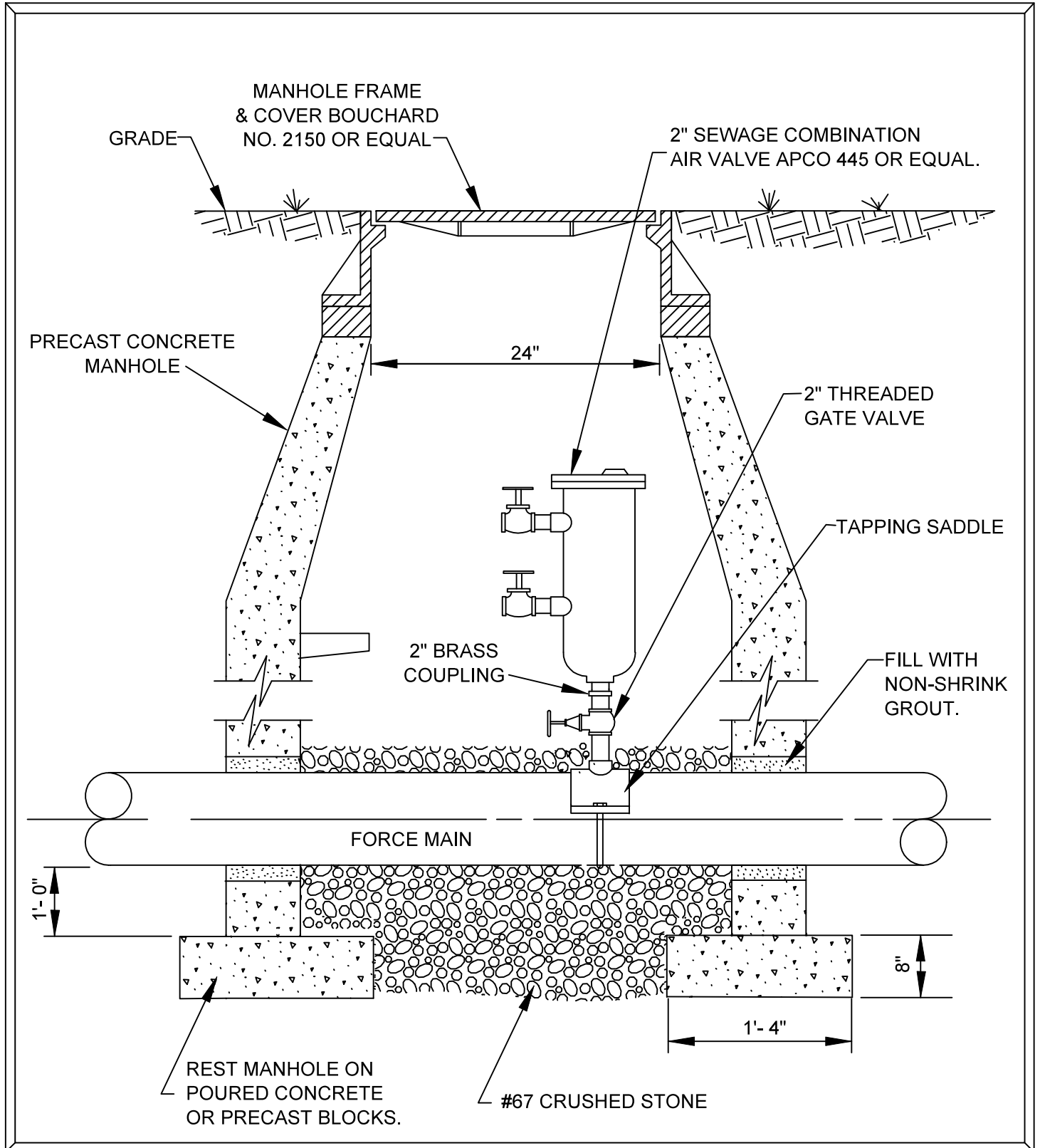
DRAWN BY: A.H.W.F.
APPROVED BY: K.N.H.

**SANITARY SEWER
SERVICE LINE**
DRAWING 1 OF 2

STANDARD
DRAWING NO.
S - 30A

MURFREESBORO WATER & SEWER DEPARTMENT

MURFREESBORO WATER & SEWER DEPARTMENT



DRAWING NOT TO SCALE

MAY 27, 1994

DRAWN BY: M.H. & A.H.W.F.
 APPROVED BY: K.N.H.
 DATE REVISED: 01/29/19 VHS

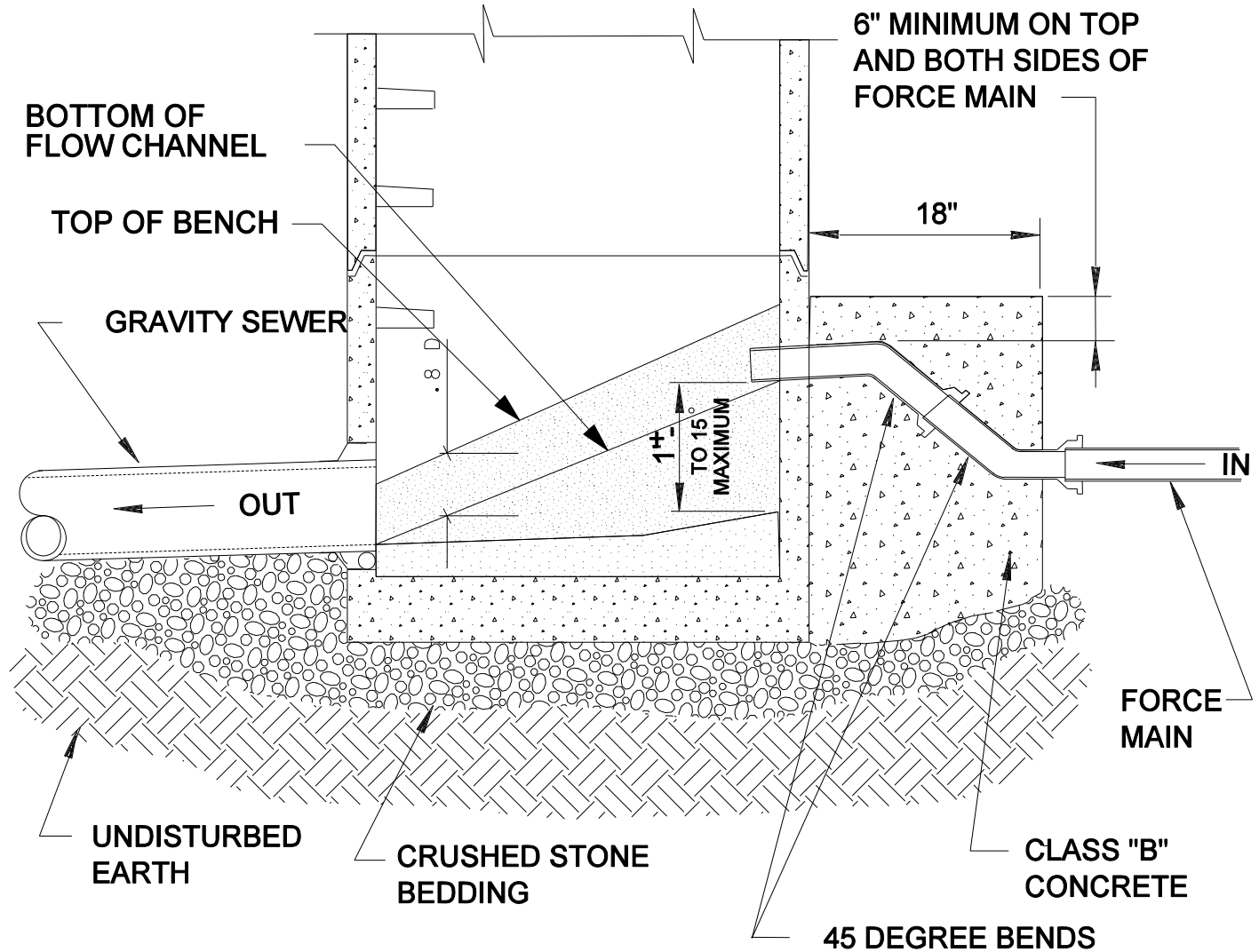
COMBINATION AIR VALVE SEWAGE FORCE MAIN

STANDARD
DRAWING NO.

S - 40

MURFREESBORO WATER & SEWER DEPARTMENT

NOTE: ENTER WALL APPROXIMATELY 1'
ABOVE CHANNEL IN FLOOR OF MANHOLE



NOTE:
SEE STANDARD DRAWINGS
S-1, S-2, S-3, AND S-4 FOR
MANHOLE DETAILS

DRAWING NOT TO SCALE

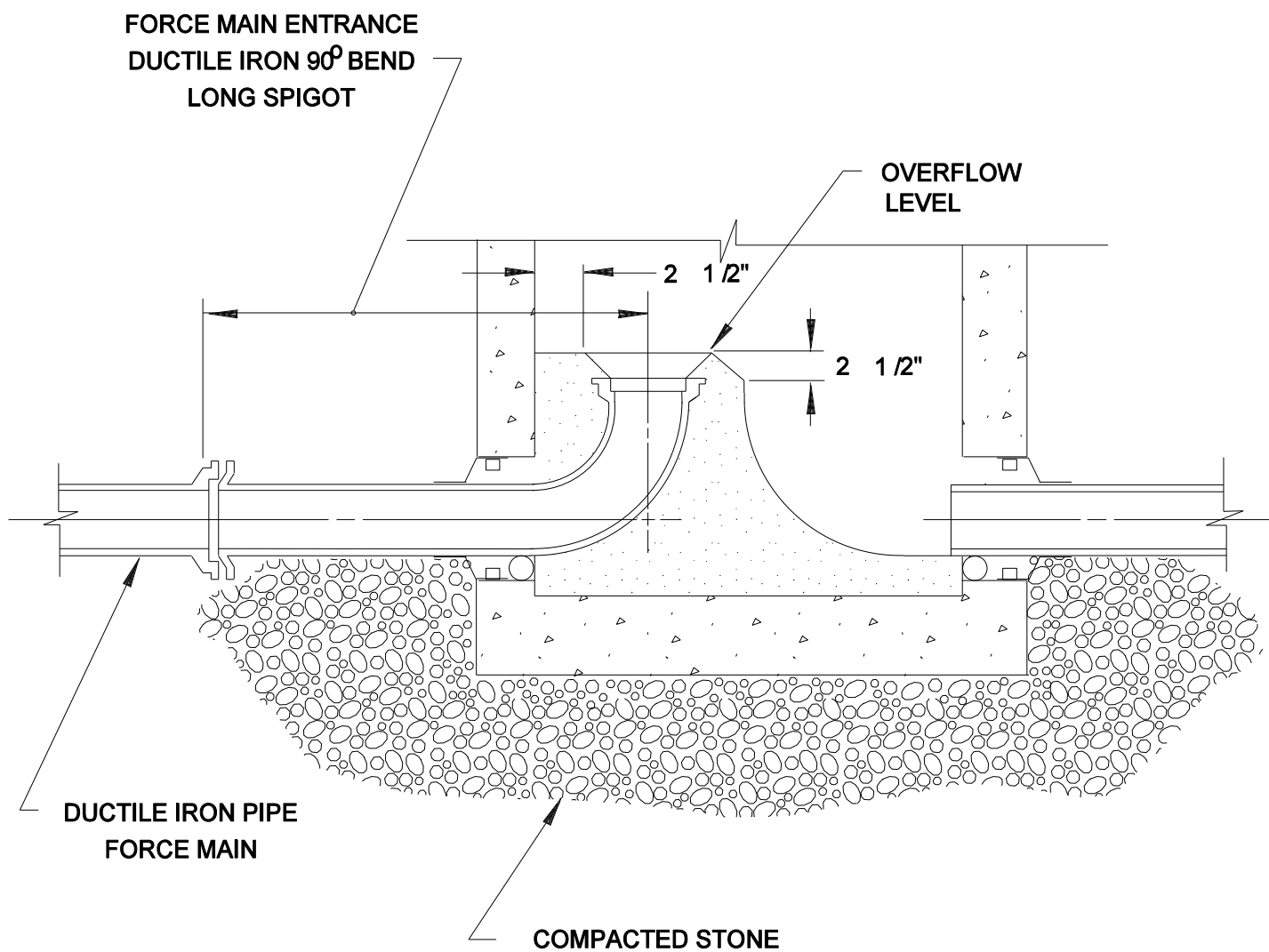
MAY 27, 1994

DRAWN BY: A.H.W.F.
APPROVED BY: K.N.H.
DATE REVISED: 3/5/02 KMC

CONNECTION OF
FORCE MAIN TO
EXISTING MANHOLE

STANDARD
DRAWING NO.
S - 41 A

MURFREESBORO WATER & SEWER DEPARTMENT



NOTE:
SEE STANDARD DRAWINGS
S-1, S-2, S-3, AND S-4
FOR MANHOLE DETAILS

DRAWING NOT TO SCALE

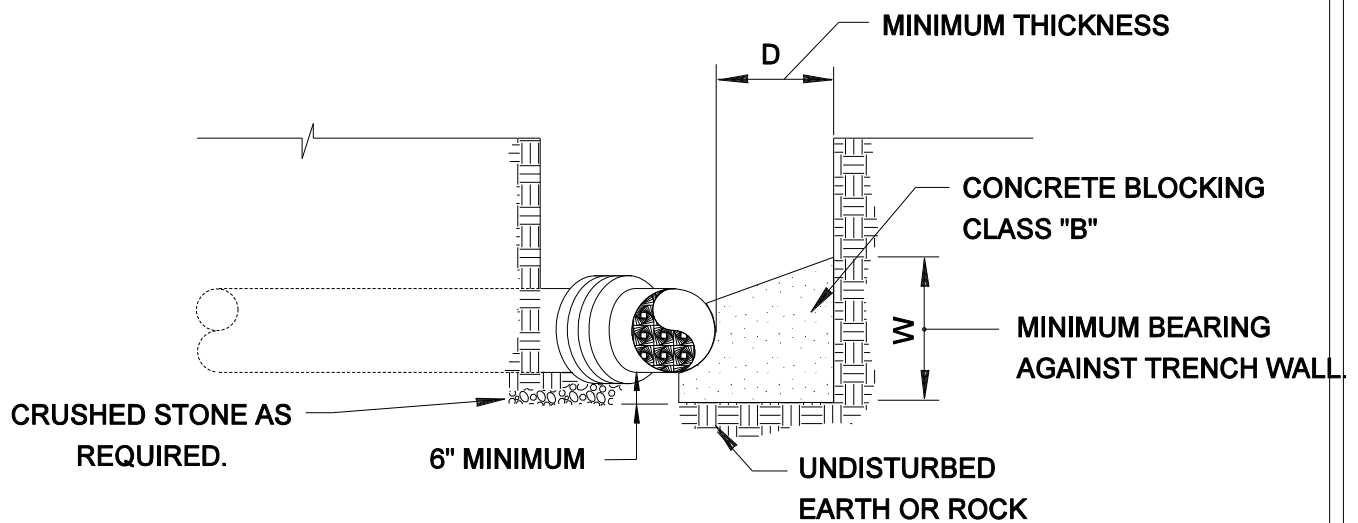
MAY 27, 1994

DRAWN BY: A.H.W.F.
APPROVED BY: K.N.H.

CONNECTION OF FORCE MAIN
TO NEW MANHOLE

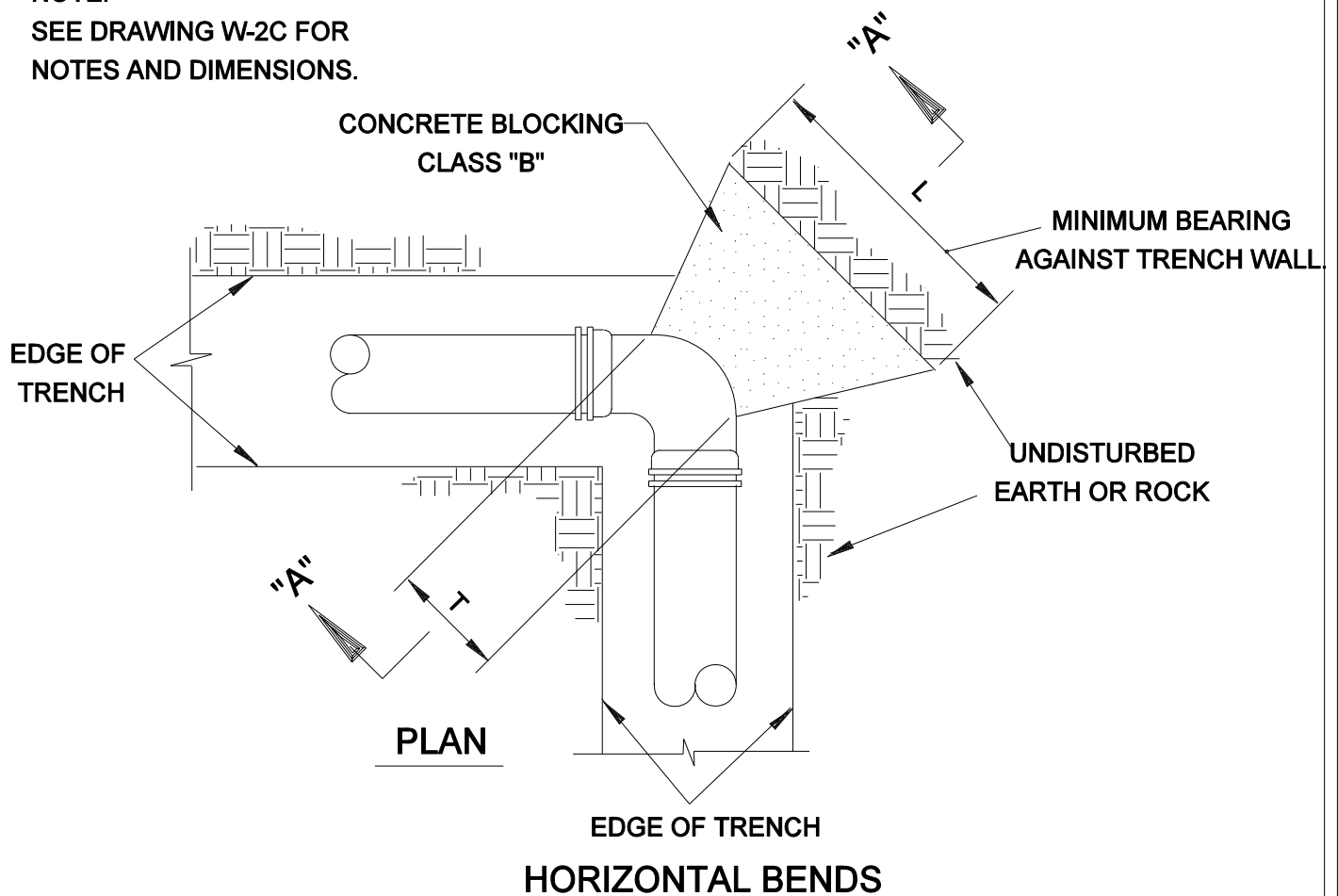
STANDARD
DRAWING NO.
S - 41B

MURFREESBORO WATER & SEWER DEPARTMENT



SECTION "A-A"

NOTE:
SEE DRAWING W-2C FOR
NOTES AND DIMENSIONS.



DRAWING NOT TO SCALE

MAY 27, 1994

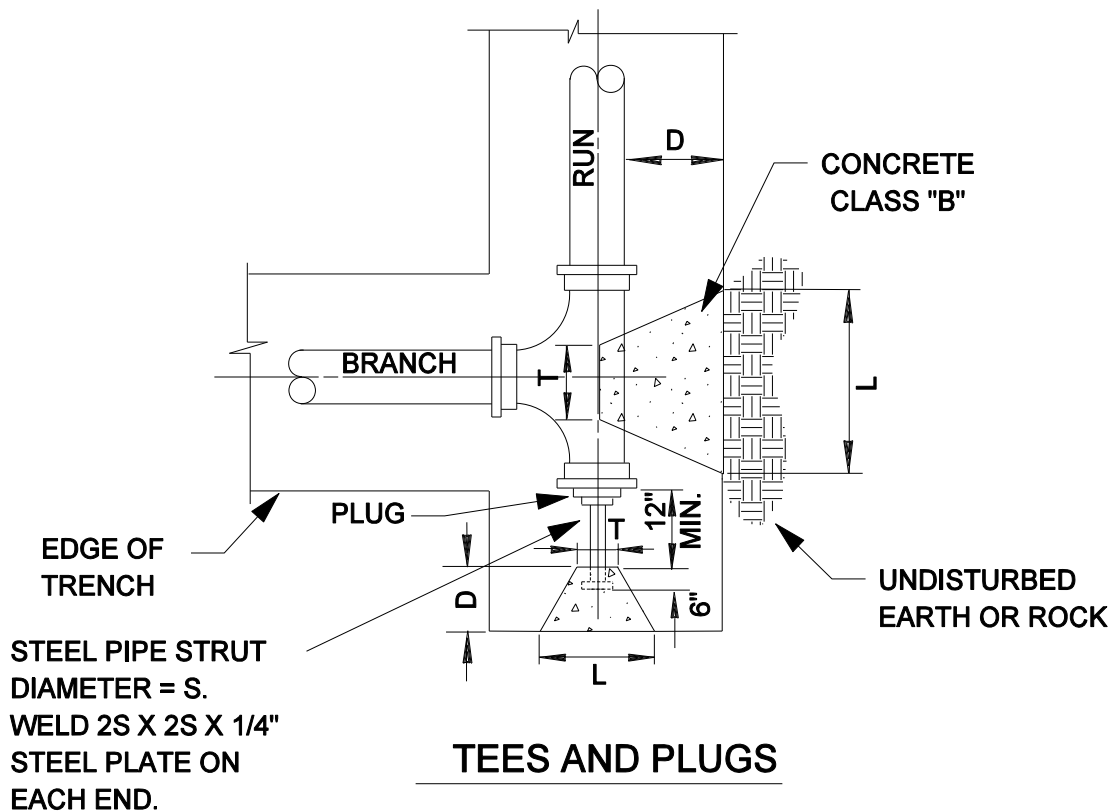
DRAWN BY: A.H.W.F.
APPROVED BY: K.N.H.

**CONCRETE
THRUST BLOCKING**
DRAWING 1 OF 3

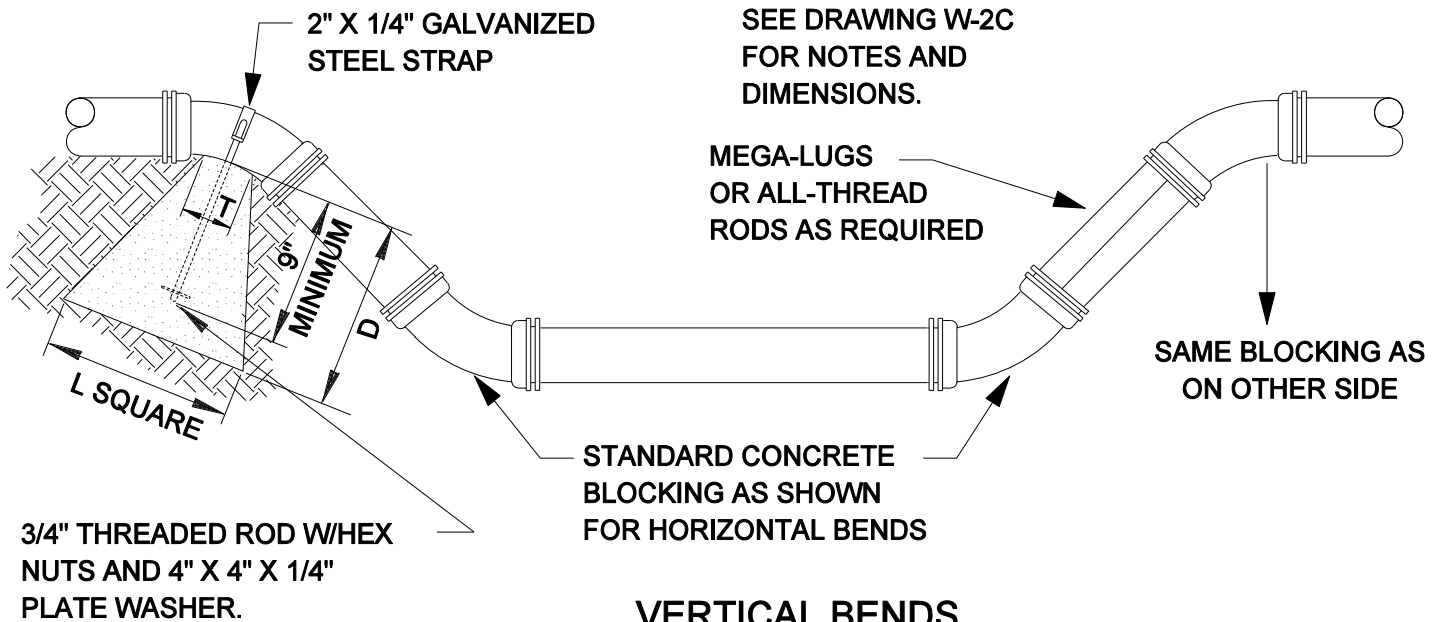
STANDARD
DRAWING NO.

S - 42A

MURFREESBORO WATER & SEWER DEPARTMENT



NOTE:
SEE DRAWING W-2C
FOR NOTES AND
DIMENSIONS.



DRAWING NOT TO SCALE

MAY 27, 1994
DRAWN BY: A.H.W.F.
APPROVED BY: K.N.H.
DATE REVISED: 3/5/02 KMC

CONCRETE
THRUST BLOCKING
DRAWING 2 OF 3

STANDARD
DRAWING NO.
S - 42B

MURFREESBORO WATER & SEWER DEPARTMENT

TABLE OF DIMENSIONS FOR CONCRETE BLOCKING

SIZE	90° BEND				45° BEND				22 1/2° BEND				11 1/4° BEND			
PIPE	L	T	W	D	L	T	W	D	L	T	W	D	L	T	W	D
4"	24"	12"	24"	8"	18"	8"	12"	8"	18"	8"	12"	8"	15"	8"	12"	6"
6"	24"	15"	24"	8"	18"	10"	12"	8"	18"	10"	12"	8"	18"	10"	18"	6"
8"	36"	16"	30"	8"	24"	12"	18"	8"	24"	12"	18"	8"	24"	12"	18"	8"
10"	48"	20"	36"	10"	30"	14"	24"	10"	30"	14"	24"	10"	24"	14"	18"	8"
12"	54"	24"	48"	10"	36"	16"	30"	10"	36"	16"	30"	10"	30"	16"	24"	10"
14"	60"	28"	60"	12"	42"	16"	42"	12"	42"	16"	42"	12"	33"	16"	27"	12"
16"	66"	32"	63"	12"	48"	18"	48"	12"	48"	18"	48"	12"	36"	18"	30"	12"
18"	66"	36"	66"	14"	54"	18"	54"	14"	54"	18"	54"	14"	39"	18"	33"	14"
20"	72"	40"	69"	14"	60"	20"	60"	14"	60"	20"	60"	14"	42"	20"	36"	14"
24"	84"	48"	75"	18"	72"	22"	72"	18"	72"	22"	72"	18"	48"	22"	42"	18"

SIZE	TEE				PLUG				
PIPE	L	T	W	D	L	T	W	D	S
4"	18"	12"	12"	8"	18"	12"	18"	18"	2"
6"	18"	12"	12"	8"	18"	12"	18"	18"	2"
8"	30"	12"	24"	8"	30"	18"	30"	24"	4"
10"	36"	18"	30"	10"	36"	18"	36"	24"	4"
12"	48"	18"	36"	10"	42"	18"	42"	24"	4"
14"	54"	24"	42"	12"	48"	18"	48"	30"	6"
16"	60"	24"	48"	12"	54"	18"	54"	30"	6"
18"	66"	30"	54"	14"	60"	24"	60"	36"	6"
20"	72"	30"	60"	14"	66"	24"	66"	36"	8"
24"	84"	36"	72"	18"	78"	30"	78"	42"	8"

NOTES:

- 1) FOR TEE WITH BRANCH UNEQUAL TO RUN USE TEE TYPE KICKER WITH D, L, AND W DIMENSIONS THE SAME AS THOSE FOR PLUG WITH SAME DIAMETER AS BRANCH OF TEE. SELECT "T" DIMENSIONS FROM TEE TABLE UNDER COLUMN HEADED BY THE SIZE OF THE BRANCH.
- 2) IF EXACT SIZE PIPE BLOCKING IS NOT SHOWN USE NEXT LARGER SIZE.
- 3) DEPTH "D" MAY BE GREATER THAN SPECIFIED TO ALLOW WORKING SPACE. BLOCKING MUST BE PLACED AGAINST UNDISTURBED EARTH OR ROCK.
- 4) CONCRETE BLOCKING SHALL BE CLASS "B".

DRAWING NOT TO SCALE

MAY 27, 1994

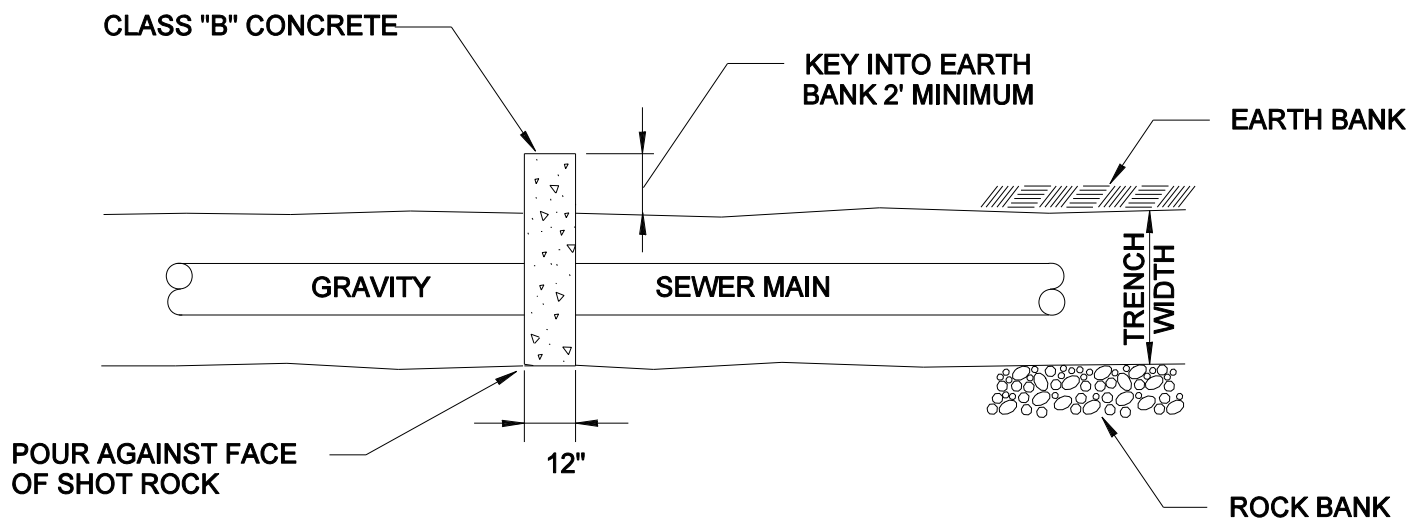
DRAWN BY: A.H.W.F.
APPROVED BY: K.N.H.

CONCRETE THRUST BLOCKING

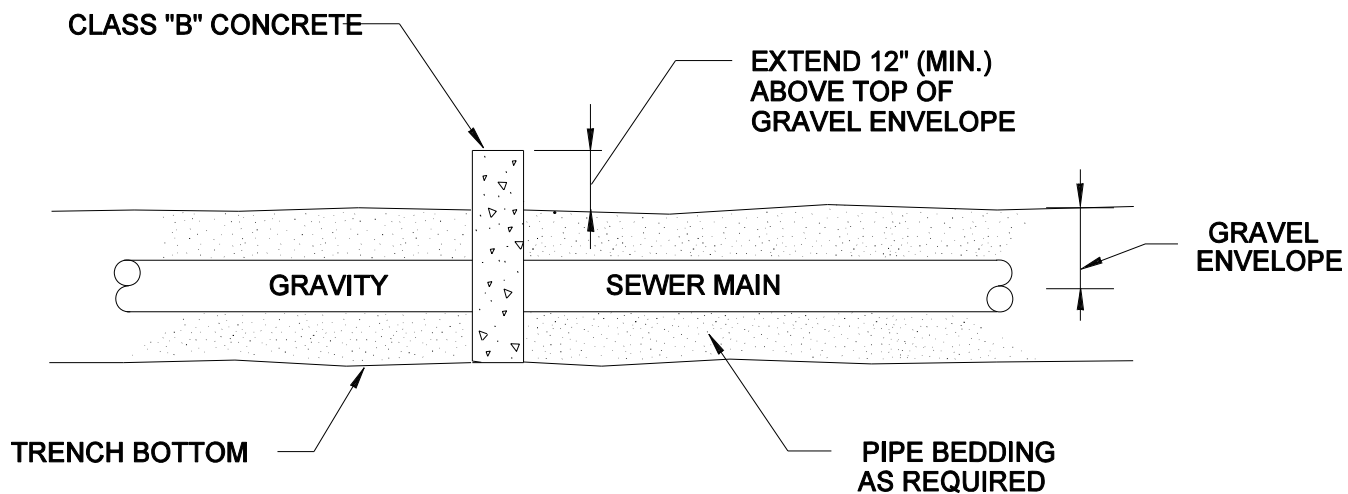
DRAWING 3 OF 3

STANDARD
DRAWING NO.
S - 42C

MURFREESBORO WATER & SEWER DEPARTMENT



PLAN



SECTION

DRAWING NOT TO SCALE

DECEMBER 3, 1998

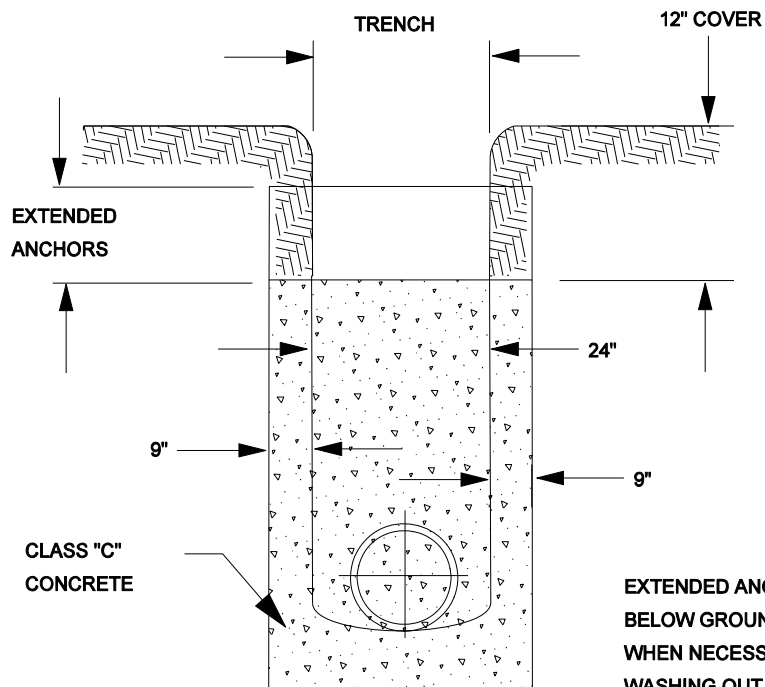
DRAWN BY: E.A.M.V.
APPROVED BY: V.H.S.

TYPICAL CONCRETE CHECK DAM

STANDARD
DRAWING NO.

S-43

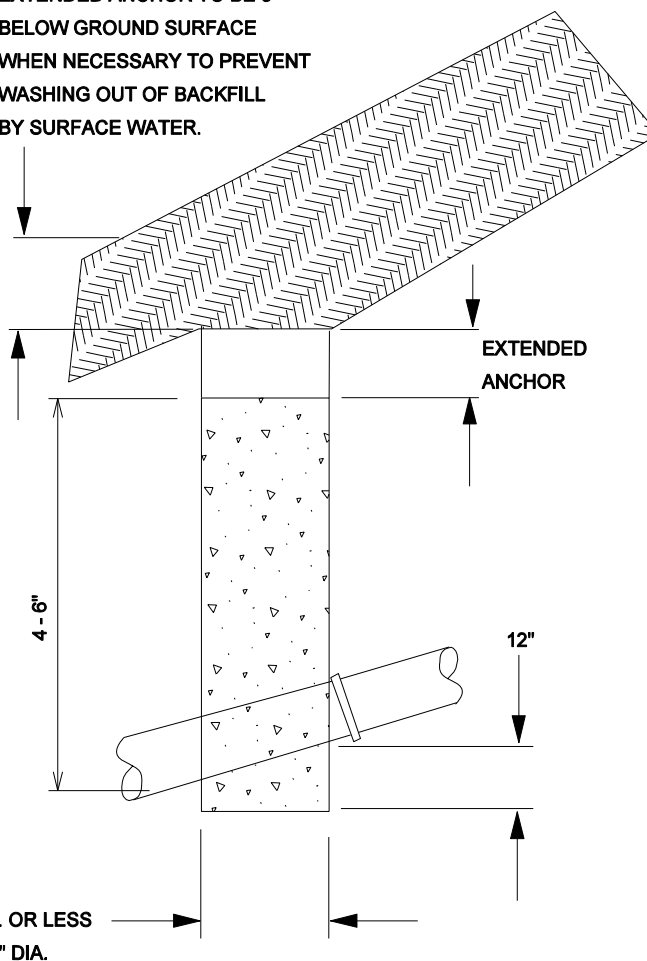
MURFREESBORO WATER & SEWER DEPARTMENT



EXTENDED ANCHOR TO BE 6\" BELOW GROUND SURFACE WHEN NECESSARY TO PREVENT WASHING OUT OF BACKFILL BY SURFACE WATER.

SEWERS ON 15 PERCENT SLOPE OR GREATER SHALL BE ANCHORED SECURELY WITH CONCRETE ANCHORS OR EQUAL. SUGGESTED MINIMUM ANCHORAGE SPACING IS AS FOLLOWS:

1. NOT OVER 36 FEET CENTER TO CENTER ON GRADES 15 PERCENT AND UP TO 25 PERCENT.
2. NOT OVER 24 FEET CENTER TO CENTER ON GRADES 25 PERCENT AND UP TO 35 PERCENT.
3. NOT OVER 16 FEET CENTER TO CENTER ON GRADES 35 PERCENT AND OVER.



12\" - FOR SEWER 12\" DIA. OR LESS
18\" - FOR SEWER 14\" - 24\" DIA.

DRAWING NOT TO SCALE

DECEMBER 1, 2005
DRAWN BY: KMC
APPROVED BY: VHS

CONCRETE ANCHOR DETAILS

STANDARD
DRAWING NO.
S-45

MURFREESBORO WATER & SEWER DEPARTMENT